samlexpower®

G4 InverCharge Inverter/Charger
Pure Sine Wave

Models:
G4-2012A
G4-2524A
G4-3524A

OWNER'S MANUAL

Please read this manual BEFORE operating.

IMPORTANT NOTES

1. **This inverter charger is VERY HEAVY and is shipped in a strong and sturdy shipping carton with appropriate foam inserts / padding to prevent damage during shipping.**

   PLEASE RETAIN CARTON FOR RE-USE in case the unit is required to be shipped back for warranty service.

2. **The following white papers containing important supplementary information on basic concepts and application are available online at Samlex America, Inc. website: www.samlexamerica.com (Home > Support > White Papers)**

   These have been referred to in this manual for additional information for better understanding of principles of working and operation:

   1. Safety When Operating Inverters
   2. Characteristics Of Sine Wave AC Power
   3. Advantages Of Pure Sine Wave Inverter Over Modified Sine Wave Inverter
   4. Grid / Utility Power Generation & Distribution
   5. Grounded Electrical Power Distribution System
   6. Grounding And Lightning / Ground Fault Protections
   7. Neutral To Ground Switching In RV And Marine Applications
   8. 120 / 240 VAC Single Split Phase System And Multi-Wire Branch Circuits
   9. Limiting Electromagnetic Interference (EMI)
   10. Inverters – General Information
   11. Advantages Of Inverter Power Over Generator Power
   12. Batteries, Chargers And Alternators

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SECTION 1 | Safety Instructions

IMPORTANT SAFETY INSTRUCTIONS

SAVE THESE INSTRUCTIONS. THIS MANUAL CONTAINS IMPORTANT INSTRUCTIONS FOR MODELS G4-2012A, G4-2524A & G4-3524A THAT SHALL BE FOLLOWED DURING INSTALLATION & MAINTENANCE OF THE INVERTER-CHARGER.

The following symbols will be used in this manual to highlight safety and important information:

WARNING! Indicates possibility of physical harm to the user in case of non compliance
ATTENTION! *Il y a une possibilité de faire du mal physique à l'utilisateur si les consignes de sécurités sont pas suivies*

CAUTION! Indicates possibility of damage to the equipment in case of non compliance
ATTENTION! *Il y a une risque de faire des dégâts à l'équipement si l'utilisateur ne suit pas les instructions*

INFO Indicates useful supplemental information

Please read these instructions BEFORE installing or operating the unit to prevent personal injury or damage to the unit.

WARNING!

1. **This equipment employs components that tend to produce arcs or sparks:** To prevent fire or explosion, do not install in compartments containing batteries or flammable materials.
2. Risk of electric shock: Use only the ground-fault circuit-interrupter [receptacle(s) or circuit breaker(s)] specified in the installation and operating instructions manual supplied with this inverter. Other types may fail to operate properly when connected to this inverter equipment.
3. Do not install on or over combustible surfaces.
4. Do not touch non-insulated portions of battery terminals.
5. Reverse battery hook up will damage the inverter.
6. For continued protection against risk of fire or electric shock replace only with same type and ratings of fuse.

   Maximum external battery fuse ratings (refer to Table 5.1, page 27):
   - 32VDC / 195A for model G4-2524A
   - 32VDC / 290A for model G4-3524A
   - 32VDC / 320A for model G4-2012A
7. **Grounding:** The grounding symbol below is used for identifying only the field wiring equipment-grounding terminal. However, this symbol is usable with the circle omitted for identifying various points within the unit that are bonded to ground.

Grounding Symbol / *Défaut à la terre*

ATTENTION!

1. *Cet équipement se sert des composants qui ont tendance à produire des arcs électriques ou des étincelles: Afin de prévenir une explosion ou un incendie, n'installer pas dans les compartiments qui contiennent des batteries ou des matériaux combustibles.*
2. ***Une risque de décharge électrique:*** *Utiliser seulement le disjoncteur-défaut à la terre [réceptacle(s) ou disjoncteur(s)] énumèré(s) dans le guide des instructions d'installation et fonctionnement qui est fourni avec l'onduleur. Des autres disjoncteurs pourrait échouer quand ils sont branchés à l'onduleur.*
3. *N'installez pas sur ou au-dessus des surfaces combustibles*
4. *Ne touchez pas les parties des bornes de batterie qui sont pas isolées.*
5. *Si les batteries sont branchées à l'envers, ça va endommager l'onduleur.*
6. *Si ça devient nécessaire de remplacer les fusibles, remplacer les seulement avec le même classement que ceux du départ, afin de réduire les risques d'incendie ou de décharge électrique.*

   Les classements maximales de fusible externe de batterie (Voir la Table 5,1, à la page 27):
   - *32 VCC / 195A pour le modèle G4-2524A*
   - *32 VCC / 290A pour le modèle G4-3524A*
   - *32 VCC / 320A pour le modèle G4-2012A*
7. ***Le défaut à la terre:*** *Le symbole du défaut à la terre est utilisé spécifiquement pour indiquer l'équipement de câblage-borne à la terre.Cependant, si cet symbole apparaît sans un cercle, il est utilisé pour identifier des parties de l'équipement qui sont liées à la terre.*

SECTION 1 | Safety Instructions

WARNING!

1. To reduce risk of electric shock and fire:
   - Both AC and DC voltage sources are terminated inside this equipment. Each circuit must be individually disconnected before servicing.
   - Do not connect to a circuit operating at more than 150 Volts to Ground.
   - Do not connect to an AC load center (circuit breaker panel) having multi wire branch circuits connected.
   - Do not remove cover. No user serviceable parts inside. Refer servicing to qualified service personnel. Do not expose to rain or spray.
   - Do not cover or obstruct ventilation openings. Do not mount in zero-clearance compartment. Overheating may result.
2. Provided with integral protection against overloads.
3. Hot Surfaces: To prevent burns, do not touch.
4. Use 90˚C / 194˚F copper conductors only for supply connections.
5. For indoors use only.
6. Tightening torques to be applied to the wiring terminals are given in the Table below:

Battery Input Connectors	External Charger Input Connectors	AC Input & Output Connectors
70 Kgf.cm (5.0 lbf.ft)	35 Kgf.cm (2.5 lbf.ft)	7 to 12 Kgf.cm (0.5 to 0.9 lbf.ft)

7. Maximum sizes of wires to be used for field connectors are specified in the Table given below (to meet conductor size and bending space requirements under Sections 16.1.3, 17.2 and 63.27 of UL-1701):

	Size of wire for battery input side	Size of wire for external charger input side	Size of wire for AC input & output sides
G4-2012A	MCM/kcmil 300	AWG #4	AWG #8
G4-2524A	AWG #2/0	AWG #4	AWG #8
G4-3524A	MCM/kcmil 250	AWG #4	AWG #6

ATTENTION!

1. *Pour réduire les risques de décharge électrique et d'incendie:*
   - *Les deux sources de tension CC et CA terminent dans l'équipement. Il faut déconnecter chaque circuit avant de l'utiliser*
   - *Ne connectez pas à un circuit qui fonctionne à plus que 150V à la terre.*
   - *Ne connectez pas à un centre de charge CA (panneau de disjonction) ayant des circuits multi-fil qui sont connectés*
   - *Enlevez pas la couverture. Les parties doivent être réparées par un(e) professionel(le) certifié(e) pas par l'utilisateur. Ne l'exposez pas à l'eau*
   - *Pour éviter la surchauffe, ne couvrez ni bloquez les ouvertures de ventilation. Ne le montez pas dans un compartiment qui n'est pas bien dégagé.*
2. *Fourni avec une protection intégrale contre des surcharges*
3. *Des Surfaces Chaudes: Pour prévenir des brûlures, ne le touchez pas.*
4. *Utiliser seulement des conducteurs en cuivre de 90˚C / 194˚F pour des connexions d'alimentation.*
5. *À utiliser exclusivement à l'interieure*
6. *Les torques de serrage qui sont appliquées aux bornes de serrage sont montrées dans la table ci-dessous:*

Connecteurs d'entrée à la batterie	*Connecteurs d'entrée au chargeur externe*	*Connecteursd'entrée et sortie CA*
70 Kgf.cm	*35 Kgf.cm*	*7 to 12 Kgf.cm*
(5.0 lbf.ft)	*(2.5 lbf.ft)*	*(0.5 to 0.9 lbf.ft)*

7. *La taille maximale du câblage est spécifiée dans la table ci-dessous (pour que la taille du conducteur et l'espace (pour fléchir) soient conformes aux normes des sections 16.1.3 , 17.2 et 63.27 des normes Ul-1701:*

	Taille du câblage pour le côté d'entrée de la batterie	***Taille du câblage pour le côté d'entrée du chargeur externe***	***Taille du câblage pour les côtés d'entrée et sortie CA***
G4-2012A	*MCM/kcmil 300*	*AWG #4*	*AWG #8*
G4-2524A	*AWG #2/0*	*AWG #4*	*AWG #8*
G4-3524A	*MCM/kcmil 250*	*AWG #4*	*AWG #6*

SAFETY INSTRUCTIONS - GENERAL

Installation and wiring compliance

- Installation and wiring must comply with the Local and National Electrical Codes and must be done by a certified electrician.

Preventing electrical shock

- Always connect the grounding connection on the unit to the appropriate grounding system.
- Disassembly / repair should be carried out by qualified personnel only.
- Disconnect all AC and DC side connections before working on any circuits associated with the unit. Turning the ON /OFF Key on the unit to OFF position may not entirely remove dangerous voltages.

SECTION 1 | Safety Instructions

- Be careful when touching bare terminals of capacitors. Capacitors may retain high lethal voltages even after power has been removed. Discharge capacitors before working on the circuits.

Installation environment

- The inverter should be installed indoor only in a well ventilated, cool, dry environment
- Do not expose to moisture, rain, snow or liquids of any type.
- To reduce the risk of overheating and fire, do not obstruct the suction and discharge openings of the cooling fans.
- To ensure proper ventilation, do not install in a low clearance compartment.
- During operation, the surface of the unit may become hot. The unit should be installed so it is not likely to come into contact with people.

Preventing fire and explosion hazards

- Working with the unit may produce arcs or sparks. Thus, the unit should not be used in areas where there are inflammable materials or gases requiring ignition protected equipment. These areas may include spaces containing gasoline-powered machinery, fuel tanks, and battery compartments.

Precautions when working with batteries.

- Batteries contain very corrosive diluted Sulphuric Acid as electrolyte. Precautions should be taken to prevent contact with skin, eyes or clothing.
- Batteries generate Hydrogen and Oxygen during charging resulting in evolution of explosive gas mixture. Care should be taken to ventilate the battery area and follow the battery manufacturer's recommendations.
- Never smoke or allow a spark or flame near the batteries.
- Use caution to reduce the risk of dropping a metal tool on the battery. It could spark or short circuit the battery or other electrical parts and could cause an explosion.
- Remove metal items like rings, bracelets and watches when working with batteries. Batteries can produce a short circuit current high enough to weld a ring or the like to metal and thus, cause a severe burn.
- If you need to remove a battery, always remove the ground terminal from the battery first. Make sure that all the accessories are off so that you do not cause a spark.

SAFETY INSTRUCTIONS - INVERTER RELATED

Preventing Paralleling of the AC Output

The AC output of the unit should never be connected directly to an Electrical Breaker Panel / Load Center which is also fed from the utility power / generator.

Such a direct connection may result in parallel operation of the different power sources and AC power from the utility / generator will be fed back into the unit which will instantly damage the output section of the unit and may also pose a fire and safety hazard.

If an Electrical Breaker Panel / Load Center is fed from this unit and this panel is also required to be fed from additional alternate AC sources, the AC power from all the AC sources like the utility / generator / this unit should first be fed to an Automatic / Manual Selector Switch and the output of the Selector Switch should be connected to the Electrical Breaker Panel / Load Center.

CAUTION!

To prevent possibility of paralleling and severe damage to the unit, never use a simple jumper cable to connect the AC output of the unit to a handy wall receptacle in the home / RV.

ATTENTION!
Afin de d'éviter la possibilité que l'appareil se met en parallèle ou devient fortement endommagé, utilisez pas un câble de raccordement pour lier la sortie CA de l'appareil à un réceptacle du murcommode dans la maison/VR.

Connecting to Multi-Wire Branch Circuits

Do not directly connect the Hot / Line output of this unit simultaneously to the two Hot Legs L1 and L2 of the 120 / 240 VAC Split Phase Electrical Breaker Panel / Load Center where Multi-Wire (common Neutral) Branch Circuit Wiring method is used for distribution of AC power. This may lead to overloading / overheating of the Neutral conductor of the distribution wiring system and is a risk of fire.

A suitable external transformer with a Split Phase output (Isolated or Auto-Transformer) of suitable power rating (25% more than the Apparent Power (VA) rating of this unit) with Primary of 120 VAC and Secondary of 120 / 240 VAC (Two 120 VAC Split Phases 180 degrees apart) should be used. The Hot and Neutral of the 120 VAC output of this unit should be fed to the Primary of this external transformer and the 2 Hot outputs (120V AC Split Phases) and the Neutral from the Secondary of this external transformer should be connected to the two Hot Legs L1 and L2 of the 120 / 240 VAC Electrical Breaker Panel / Load Center.

Please read details under White Paper titled "120 / 240 VAC Single Split Phase System and Multi-wire Branch Circuits" that is available online at www.samlexamerica.com (Home > Support > White Papers).

Preventing Input Over-Voltage

It is to be ensured that the DC input voltage of this unit is ≤ 16 VDC for the 12V battery version and ≤ 32 VDC for the 24V battery version

SECTION 1 | Safety Instructions

to prevent permanent damage to the unit. Please observe the following precautions:

- Ensure that the maximum charging voltage of the external battery charger / alternator / solar charge controller is ≤ 16 VDC for the 12V battery version and ≤ 32 VDC for the 24V battery version
- Do not use unregulated solar panels to charge the battery connected to this unit. Under cold ambient temperatures, the output of the solar panel may reach >22 VDC for 12V Battery System and > 44 VDC for the 24V Battery system. Always use a charge controller between the solar panel and the battery.
- Do not connect this unit to a battery system with a voltage higher than the rated battery input voltage of the unit (e.g. do not connect the 12V version of the unit to 24V battery system or the 24V version to the 48V Battery System)

Preventing Reverse Polarity on the Input Side

When making battery connections on the input side, make sure that the polarity of battery connections is correct (Connect the Positive of the battery to the Positive terminal of the unit and the Negative of the battery to the Negative terminal of the unit). If the input is connected in reverse polarity, DC fuse(s) in the input side will blow and may also cause permanent damage to the inverter.

CAUTION!

Damage caused by reverse polarity is NOT covered by warranty.

ATTENTION!
Des dégats causés par un renversement des polarités n'est pas couverts par la garantie.

Using Generator as External Input Source with Inverter Chargers

The AC output voltage of a generator is proportional to its rotational speed (RPM – Revolutions Per Minute) and the current fed to its field windings. The frequency of the AC output voltage produced by the generator is proportional to the RPM of the engine and the number of poles used in the generator. The RPM of the generator is controlled and kept constant by the mechanical governor installed on the engine that is driving the generator. The output voltage of the generator is controlled by its electrical voltage regulator, which controls the current fed to its field windings.

When an electrical load is applied to the generator, its output voltage tends to drop and the speed of the engine also tends to drop leading to drop in the output frequency and additional drop in the output voltage. The drop in the RPM of the engine is countered by the engine governor by feeding more fuel to the engine. The drop in voltage of the generator is countered by the voltage regulator of the generator by increasing the current fed to the field windings.

Similarly, when a load is removed from the generator, its output voltage tends to rise and the RPM of the engine also tends to rise leading to increase in the output frequency and additional increase in the output voltage. The increase in the RPM of the engine is countered by the engine governor by reducing the fuel supply to the engine. The rise in the output voltage of the generator is countered by the voltage regulator of the generator by decreasing the current fed to the field windings.

The mechanical governor and electrical voltage regulator have sensitivity of producing controlling action to correct a deviation of the controlled parameter. Higher sensitivity tends to produce oscillations around the controlled value. Hence, when these devices try to control very fast moving parameters, they will produce larger oscillations before settling down. The voltage regulator will tend to produce high voltage transients during this time. **These symptoms are seen during the start up and shut down of the engine-generator.**

For 60 Hz frequency of AC voltage, the engine speeds should be 3600 RPM for 2 pole, 1800 RPM for 4 pole and 1200 RPM for 6 pole generators.

When a generator is started, it is cold and it starts from 0 RPM and reaches the rated RPM within a finite time. Thus, during the initial period of ramping up from 0 RPM to the rated RPM, its frequency and output voltage will be fluctuating due to the regulating action of the mechanical governor and the electrical voltage regulator. As this happens in a very short duration, during this period, the output frequency will fluctuate and the output voltage will also fluctuate and will contain a lot of high voltage transients that are produced by the extremely fast regulating actions of the mechanical governor and the voltage regulator. These voltage and frequency fluctuations and high voltage transients can damage the AC loads that are fed from the generator. Also, the engine needs some time to warm up and stabilize in its mechanical operation. **Normally, the engine- generator should be warmed up for at least 10 minutes before loading the generator.**

The same fluctuations in frequency and voltage and appearance of high voltage transients will be seen at the output of the generator at the time of shutting down the engine.

CAUTION!

It is very important that all AC loads on the output of the generator are switched on only after around 10 minutes of generator starting. This ensures that the engine and generator have warmed up sufficiently and that the generator is providing stable frequency and well regulated, cleaner, transient-free output voltage to prevent damage to the AC loads / Inverter Charger. Similarly, the AC loads should be disconnected first, before the engine is shut down.

ATTENTION!
C'est vraiement important que toutes les charges CA qui sont branchées au générateur sont mises en marche 10 minutes après que le générateur a démarré. Cela permet que le moteur et le générateur sotent bien réchauffés et que le générateur fourni une fréquence stable et une tension de sortie sans transition, bien reglé/propre qui empêche d'endommager les charges CA /le G4. Sembablement, les charges CA devraient être déconnecter avant que le moteur soit fermé.

SECTION 2 | Layout of G4 Series

DC SIDE LAYOUT (FIG 2.1)

1. Battery Positive (+) Input Connector – M8 Nut & Bolt (RED Protection Cover is Removed).
   1a. RED Protection Cover For Battery Positive (+) Input Connector
2 Battery Negative (-) Input Connector – M8 Nut & Bolt (Black Protection Cover is Removed)
   2a. BLACK Protection Cover for Battery Negative (-) Input Connector
3 External Charger (+) Input Connector – M8 Thumb Nut and Bolt
4 External Charger (-) Input Connector - M8 Thumb Nut and Bolt
5 DC Side Ground Connector – Wire Size AWG #4-6. Set Screw 5/16" – 24 UNF
6 6P2C Modular Connector for Temperature Sensor "BTS-G4" (Fig. 2.4)
7 8P8C Modular Connector for Remote Operation of Detachable LCD Control Panel
8 Cooling Fan 1 (Cooling Fan 2 is inside the unit and is not visible) ***Note: Cooling Fan 1 sucks cool air from outside and discharges into the unit.***

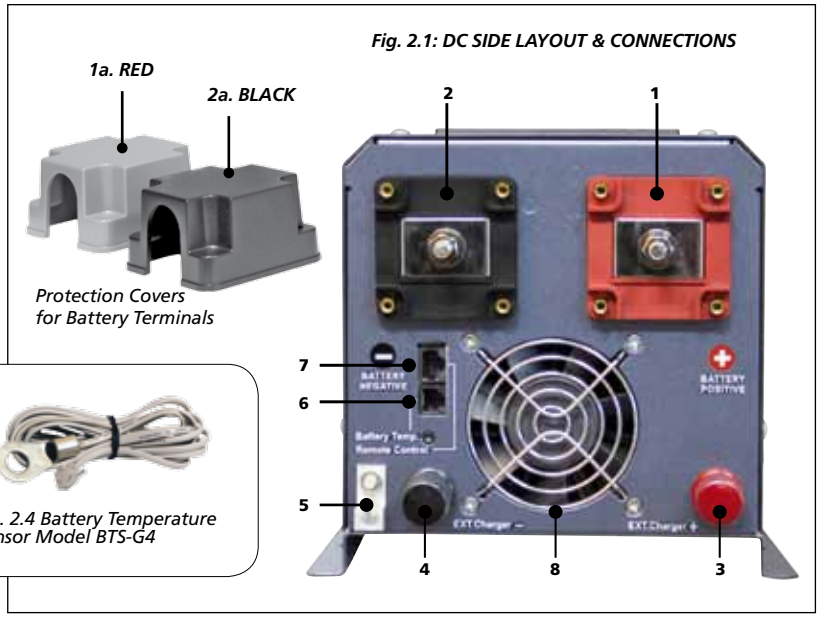


Fig. 2.1: DC SIDE LAYOUT & CONNECTIONS

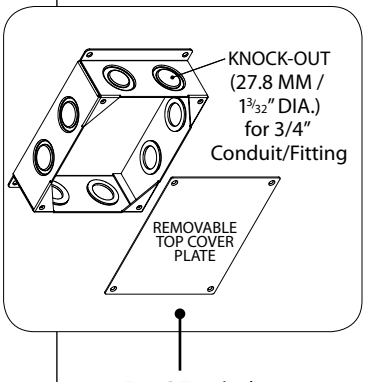
Fig. 2.4 Battery Temperature Sensor Model BTS-G4

AC SIDE LAYOUT (FIG. 2.2)

NOTE: Layout in Fig. 2.2 is shown without the AC Terminal Cover (17).

- Size of terminal slot for wire entry: 6 x 4.5 mm
- Wire size accepted by the terminal hole: AWG #6 – 20

9. HOT IN - AC Input , Hot / Line
10. NEU IN - AC Input Neutral
11. GND IN - AC Input Ground
12. GND OUT - AC Output Ground
13. NEU OUT - AC Out, Neutral
14. HOT OUT - AC Out, Hot / Line
15. AC Breaker Marked "Charger"
16. AC breaker Marked "Load"
17. Protection Cover for AC Terminal Pocket



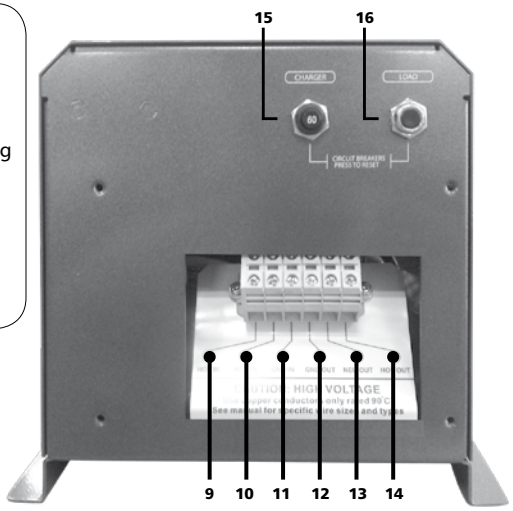


Fig. 2.2: AC SIDE LAYOUT & CONNECTIONS

DETACHABLE LCD CONTROL PANEL (FIG. 2.3)

1. LCD Screen - 2 rows of 16 characters each
2. ON/OFF Push Button
3. Green LED - Status
4. Red LED - Fault
5. Key - Set
6. Key - Up
7. Key - Down
8. Key - Enter
9. 10M, RJ-45 Data Cable with 8P8C Modular Connectors (Straight Wired) for Remote Operation of Detachable LCD Control Panel

9 - Cable for Remote Operation

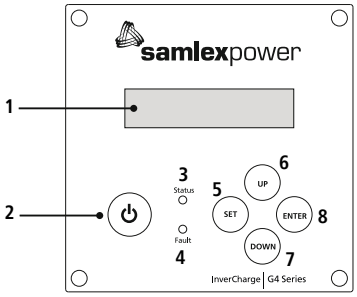


Fig. 2.3: LCD CONTROL PANEL

SECTION 3 | General Description & Principles of Operation

General Description

This unit is a Pure Sine Wave Bi-directional, Single-Phase Inverter / Charger with a Transfer Relay that operates either as an inverter OR as a smart battery charger. It uses a common Converter Section that can work in two directions – in one direction it converts external AC power to DC power to charge the batteries (Utility / Generator Mode) and in the other direction, it converts DC power from the battery to AC power (Inverter Mode). This allows the same power components to be used in both directions resulting in high-energy transfer efficiency with fewer components. Please note that it can not work in both the directions at the same time (i.e. it can not work as an inverter and as a charger at the same time).

A high performance micro-controller and Pulse Width Modulated (PWM) conversion circuits are used for the above implementation.

Components Of The System

It consists of 3 Sections – Inverter Section, Battery Charger Section and Transfer Relay Section. The unit is fed with the following inputs:

- External AC input power source – can be the Utility or a generator
- DC Battery Source - Two versions of G4 Series are available. One version is for a 12 VDC battery input (G4-2012A) & the other is for a 24 VDC battery input (G4-2524A & G4-3524A)
- Additional external charging source like Solar Charge Controller / AC charger of up to 50A capacity. The output of the external charging source is routed through this unit and operates in parallel with the internal charger. The internal charging current is controlled to ensure that the combined current fed to the battery does not exceed the programmed Bulk Charging Current. This improves the life of the battery.

Inverter Section: Is a heavy-duty, continuously working, micro-controller based inverter generating a Pure Sine Wave output of 120 VAC, 60 Hz from the DC Battery Source. It is able to supply AC power to various types of AC loads such as resistive loads (heaters, incandescent lamps etc) or reactive loads (motors, air conditioners, refrigerators, vacuum cleaners, fans, pumps, Switched Mode Power Supplies (SMPS) used in audio / video equipment and computers, etc.).

Principle of working of the Inverter Section: The low DC voltage from the DC Battery Source is inverted to the AC voltage in two steps. The low DC voltage from the DC Battery Source is first converted to low frequency (50 Hz or 60 Hz), low voltage synthesized sine wave AC using an H-bridge configuration and high frequency PWM (Pulse Width Modulation) technique. In order to create this low voltage, low frequency synthesized sine wave, a reference low frequency sine wave and a high frequency carrier wave are generated. The low frequency, low voltage synthesized sine wave is then stepped up to 120 VAC pure sine wave voltage using a low frequency Isolation Transformer and filtration circuit. This type of DC to AC inversion is called Hybrid Type – a combination of low frequency and high frequency implementation.

Soft Start in Inverter Mode: The inverter design incorporates "Soft Start" feature with the following advantages and protections:

- When the inverter is turned on, the output voltage ramps up gradually from around 40 VAC to 120 VAC in around 350 ms. This reduces otherwise very high starting inrush current drawn by AC loads like Switched Mode Power Supplies (SMPS) and motor driven loads like fans, pumps, compressors etc. This will result in lower motor inrush current (which typically can be up to 650% of the full load current of the motor), which means lesser mechanical stresses, wear and tear and increased lifetime of the motor, coupling and fan. Additionally, the impact on the load side components is greatly reduced, meaning less likelihood of causing problematic voltage drops during starting.
- When high power load or load with high starting / inrush surge is switched on when the inverter is running and supplying the full rated voltage, the output voltage will momentarily dip and ramp up again gradually. This will have the same effect as described above
- Reduction in output voltage and consequent reduction in output current due to high inrush surge conditions imposed by certain loads prevents the inverter from premature failure due to excessive overloading

Transfer Relay Section: Is used to either feed AC power to the Battery Charger Section and at the same time, pass through the AC power from the external AC input power source to the load (As long as the external AC input power source is available and is within the programmed limits of voltage and frequency) or to transfer the load to the Inverter Section (In case of loss of the external AC input power source or if this source is not within the programmed limits of voltage and frequency). Typical transfer time is 20 milliseconds. Heavy duty 80A, SPDT Transfer Relay is used for reliable transfer of up to 300% surge power and for Neutral to Ground Bond Switching.

Battery Charger Section: The Battery Charger Section of these units is a powerful, micro-controller based, 4 Stage Charger - 80A for the 12V, 2000VA version and 70A for the 24V, 2500VA and 3500VA versions. The same Isolation Transformer and the H-Bridge configuration are used to work in the reverse direction – rectify the AC voltage from the Primary AC Power Source to controlled low voltage DC to charge the DC Battery Source. That is why it is called a Bi-directional device. 4 Stage Charging Algorithm is used – Bulk, Boost, Equalization and Float. (The Equalization Stage is selectable). Equalization Stage is desirable for the proper health of Wet Cell Batteries. Further, the charging voltages and currents are programmable to take care of a wide range of battery types like flooded, AGM, Gel Cell, Lead Calcium, etc.
Please see details under Section 4 titled "Battery Charging in G4 Series" and Section 7 titled "Setting Menu and Display Screens".

Modes Of Operation

Utility Mode: As long as the external AC input power from the utility is available and is within the programmed limits of voltage and frequency, it is passed through to the AC load through the Transfer Relay Section. At the same time, the Battery Charger Section converts the external AC input power from the utility to DC power to charge the DC Battery Source. In case the utility fails, the load is transferred to the inverter in around 20 ms.

Generator Mode: As long as the external AC input power from the generator is available and is within the programmed limits of voltage **(frequency is not qualified in this Mode)**, it is passed through to the AC load through the Transfer Relay Section. At the same time, the Battery Charger Section converts the external AC input power to DC power to charge the battery (charging will be interrupted during the period when generator freqency is not within the range of 45 to 65 Hz due to overload distortion). In case the generator fails, the load is transferred to the inverter in around 20 ms.

SECTION 3 | General Description & Principles of Operation

Inverter Mode: If at any instant, the external AC input power from the utility / generator is interrupted or is not within the programmed limits of voltage and frequency, the Transfer relay is de-energized and the load is transferred to the Inverter Section and internal battery charging is terminated. This is called the Inverter Mode.

Synchronized Transfer Of Power

The AC input power can be fed to the G4 either from the utility or from a generator. Normally, the utility power has a stable frequency. However, the frequency of the generator may vary appreciably based on the value of the load and the sensitivity of engine speed governor. The frequency of a generator is proportional to the speed of the engine (specified in RPM i.e. Revolutions Per Minute). For example, for producing a frequency of 60 Hz, the generator speed has to be stable at 3600 RPM for 2-Pole generator, 1800 RPM for 4-pole generator and 1200 RPM for 6-pole generator. Normally, engine governors will keep the speed within tolerance. However, older engines or governors with deteriorated regulation will not be able to maintain a steady RPM at different loads and hence, their frequency will vary appreciably.

When a load is transferred from a primary AC source of power to another backup AC source of power through a Transfer Switch, there will be a finite interruption of power to the load for the transfer to take place. When AC power fed to a reactive load (consisting of circuit inductances and capacitances) is interrupted, the voltage across the load does not die instantaneously but dissipates in tens of milliseconds due to residual power stored in its reactive components (combination of its circuit inductances and capacitances). The voltage and phase of the residual power in the load after interruption of the AC source are the same as the voltage and phase of the AC source at the time of interruption. A mismatch of phase and frequency of the primary AC source and the backup AC source at the time of transfer is likely to damage the backup AC source / load. For a smooth and safe transfer to take place, the following conditions are required to be met:

- For a very fast and safe transfer, the phase and frequency of the backup AC source that is going to take over the load has to be synchronized with the phase and frequency of the primary AC source that is being removed from the load. A very fast transfer is desirable for sensitive loads like computers etc because a longer transfer time may crash the computer if the power supply of the computer does not have adequate "Hold Up Time" ("Hold up Time" is the duration of power interruption that can be withstood by the computer to prevent crashing. This time is usually > 20 millisecond). **In the G4 series, the phase and frequency of the internal Inverter Section is always kept synchronized with the external input from the utility / generator (within a specified window) for fast and safe transfer.**
- If the phase and frequency of the primary AC source and the backup AC source cannot be synchronized, the transfer time has to be increased considerably to allow the residual voltage in the load to dissipate before the transferee AC source is connected to the load. Longer transfer time is acceptable for general purpose loads like lighting, motors, appliances, etc.

Transfer From Inverter to Utility / Generator

Whenever the G4 Series is switched ON, it will always start in Inverter Mode first even if external utility or generator input is available. The output of the inverter ramps up from around 40 VAC to 120 VAC in around 350 ms under "Soft Start" and is slowly synchronized with the frequency of the external utility / generator and the load is transferred / by-passed to the external utility / generator when fully synchronized and at the same time, the Battery Charger Section starts charging the batteries. This preparation time for ensuring synchronized transfer from the Inverter Mode to the Utility / Generator Mode may take around 20 to 30 sec. The transfer from the Inverter Mode to the Bypass / Charger Mode will take place only under the following conditions:

- The voltage of the external utility / generator is within the limits of low and high input voltages set through the Setting Mode, Screens 2 & 3 (page 39)
- The frequency of the external utility is within + 5 Hz and – 3 Hz if Utility Mode has been selected through the Setting Mode, Screen 1 (Generator Mode Disable)
- **The frequency of the external generator is not considered if the Generator Mode is selected through the Setting Mode, Screen 1 (Generator Mode Enable). The inverter will still synchronize with the phase and frequency of the generator before the transfer takes place. Charging will be interrupted during the period when Generator frequency is outside the range of 45 Hz to 65 Hz due to overload distortion.**

NOTE: *As generators have a wider frequency fluctuation, the frequency is not considered to qualify for transfer. The inverter still synchronizes with the phase and frequency of the generator before transfer takes place. Thus, in the Generator Mode, the load will be forced to operate under the actual wider frequency variations of the generator as compared to more narrow frequency limits of + 5 to – 3 Hz in the Utility Mode. Hence, the user should ensure that when "Generator Mode" is selected, the loads should be able to handle the wider frequency variation of the generator.*

Transfer From External Utility / Generator To Inverter

After the load has been transferred to the external utility / generator, the Inverter Section is always kept synchronized in frequency and in phase with the external utility / generator voltage. In case the unit is set in Utility Mode and the utility fails or if its voltage / frequency of the utility are outside the set limits, the load is immediately transferred safely to the inverter within around 20 ms. Similarly, if the unit is set in the Generator Mode and if the generator fails or its voltage is outside the set limits, the load is safely transferred to the inverter within around 20 ms. **(Please note that in Generator Mode, the frequency is not qualified for transfer, however, charging will be interrupted during the period when generator frequency is not within the range of 45 to 65 Hz due to overload distortion).**The inverter executes a soft start and its output voltage ramps up from around 40 VAC to the full 120 VAC in around 350 ms thus reducing the inrush current drawn by the load on transferring to backup AC power.

Power Save Mode

When the unit is operating without any load connected to it, it requires some minimum input power from the battery to keep all the sections inside the unit alive and ready to deliver power to the AC load as soon as the load is switched on. This power is called the "No Load Power Draw"

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or the "Idle Power" or "Self Power Consumption" (We will call this as the "No Load Power Draw"). If the unit is on and is not powering any load, this "No Load Power Draw" is wasted as it unnecessarily drains the battery and hence, should be minimized, if possible. The "No Load Power Draw" of these units in the Normal Mode is around 35W to 45W. This unit has a provision to minimize this "No Load Power Draw", if required (Applicable only when the unit is in "Inverter Mode"). This is achieved by enabling the "Power Save Mode". When "Power Save Mode" is enabled, the unit does not provide continuous output power but discontinuous and pulsing output power consisting of only 2 to 3 cycles of reduced 40 VAC output voltage that are made available every 2.8 seconds and are used to sense if a minimum load is present or not. As continuous power is not being supplied, the "No Load Power Draw" is reduced to less than 5W. If a load > 60W is sensed, the unit exits Power Save Mode and starts providing normal continuous output power (will now consume the full 35W to 45W of "No Load Power Draw" of the Normal Mode in addition to the power consumed by the load). If the load drops to <10W, the unit once again reverts to Power Save Mode.

When the unit is operating in Power Save Mode, the Green Status LED (3, Fig 2.3) on the LCD Control Panel blinks @ 4sec. **Please read Section 8 - Operation, page 55 for activation and deactivation of Power Save Mode.**

Power Save Mode should be disabled for the following loads:

- Low power loads that draw < 60W e.g. digital clocks, satellite receivers, phones / answering machines etc.
- Audio / video / computing devices that consume normal operating power > 60 W but draw less than 10W on entering Sleep Mode when switched off or when no activity is seen for a specified time

Power Save Mode - Transfer Characteristics in Utility / Generator Mode

Transfer from Utility / Generator: If qualified Utility or Generator AC input power is available (its voltage and frequency are within the programmed range), the Transfer Relay remains energized and the AC input power is passed through to the load and at the same time, the unit operates as a battery charger. If AC input power from Utility / Generator fails or is not qualified (its voltage and frequency are not within the programmed range), the Transfer Relay is de-energized and the load is transferred to the inverter. When this transfer takes place, the inverter initially operates in Normal Mode. If the AC load was > 60W, the inverter continues in Normal Mode. However, if it does not see a load > 60W for around 5 sec, it enters Power Save Mode.

Transfer from Inverter to Utility / Generator: As soon as AC input power from Utility / Generator is available, the inverter will exit Power Save Mode and will switch over to Normal Mode. This switch over is necessary for synchronizing the AC output of the inverter with the AC input before transfer (Synchronization can not be carried out with pulsing wave form during Power Save Mode). Transfer to Utility / Generator is completed after qualification and synchronization.

Temperature Sensor for Battery Charging

Battery Temperature Sensor Model BTS-G4 (Fig 2.4, page 8) has been provided to ensure optimum charging by modifying the charging voltages based on temperature if the battery sees very wide temperature swings. Without temperature compensation, the battery life is likely to be drastically reduced because the battery will be undercharged during cold conditions (will build up sulfation) or will be overcharged during hot conditions (will boil and lose excessive water). **Please read White Paper titled "Batteries, Chargers & Alternators" available online at www.samlexamerica.com (Home > Support > White Papers) and Section 4 titled "Battery Charging in G4 Series" for more details.**

Parallel Operation With External Charger

The Battery Charger Section is able to operate in parallel with another external charging source like Solar Charge Controller / AC charger with a charging capacity of up to 50 A. The output of the external charging source is routed through this unit and operates in parallel with the internal charger. The internal charging current is controlled to ensure that the combined current fed to the battery does not exceed the programmed Bulk Charging Current. This improves the life of the battery. **Please read more details under "Benefits 8" on page 12.**

Cooling by Temperature / Load Controlled Fans.

The unit is cooled by convection and by forced air ventilation by 2 temperature / load controlled fans. One fan (8, Fig 2.1, page 8) near the DC input connectors sucks air from outside and discharges it inside the unit. A second internal fan sucks additional air from the mesh protected ventilation openings on the sides of the top cover (towards the DC input side) and discharges through the mesh-protected openings on the sides and the bottom (towards the AC output side). Logic for operation of the fans is given in Table 3.1 below:

Table 3.1 Logic for Operation of Cooling Fans

Controlling Parameter	Operational Condition of the Fan
Heat Sink Temperature	• Above 65°C, the fan switches on at 50% speed. The fan switches off when cooled below 50°C • At 85°C, fan speed rises to 100%. The fan speed drops to 50% when cooled to 70°C
Charging Current in Utility / Generator Mode	• At more than 25% of maximum charging current, the fan switches on at 50% speed and switches off when in standby • At more than 50% of maximum charging current, the fan speed rises to 100%. When charging current drops to 40% of maximum charging current, the fan speed reduces to 50%
% of load in Inverter Mode	• At 30% load, fan switches on at 50% speed. The fan switches off when load reduces to 20% • At 50% load, the fan speed rises to 100%. The fan speed drops to 50% when load reduces to 40%

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Models

The following models are covered in this manual:
G4-2012A -12 VDC Input, 120 VAC output, 2000VA
G4-2524A - 24 VDC Input, 120 VAC output, 2500VA
G4-3524A - 24 VDC Input, 120 VAC output, 3500VA

Features and Benefits

Benefit 1: This unit is a Bi-directional Inverter / Charger with a Transfer Relay that operates either as an inverter OR as a battery charger. It uses a common Converter Section that can work in two directions – in one direction it converts external AC power to DC power to charge the batteries (Utility / Generator Mode) and in the other direction, it converts the DC power from the battery to AC power (Inverter Mode). This allows the same power components to be used in both directions resulting in high-energy transfer efficiency with fewer components

Benefit 2: The waveform of the output voltage is a Pure Sine Wave like the waveform of the Utility / Grid Power / Generator. In some inverters, the output waveform is a stepped square wave (termed as Modified Sine Wave). Modified Sine Wave has a number of limitations e.g. - produces higher order harmonics leading to increased radio interference that may affect audio and video devices, produces higher heating in motors and transformers that may lead to their premature failure, is not suitable for laser printers and other devices that are based on zero crossing (clocks) or phase control (dimmers and transformer less battery chargers using SCRs). Please read White Paper titled "Advantages of Pure Sine Wave Inverter over Modified Sine Wave Inverter" available online at www.samlexamerica.com (Home > Support > White Papers).

Benefit 3: It is a powerful, cost effective, micro-controller based Inverter Charger with a Transfer Relay consisting of 3 devices in one unit - Inverter, Battery Charger and Transfer Relay. When used as an AC Power Back Up Unit in conjunction with an external AC power source, it provides an un-interruptible AC output voltage that is stable in voltage and in frequency despite interruptions, brownouts or sags in the Utility / Generator.

Benefit 4: The AC input power can be fed to the G4 either from utility or from generator. Normally, utility power has a stable frequency. However, the frequency of the generator may vary appreciably based on the value of the load and the sensitivity of engine speed governor.

When a load is transferred from a primary AC source of power to another backup AC source of power through a Transfer Switch, there will be a finite interruption of power to the load for the transfer to take place. When AC power fed to a reactive load (consisting of circuit inductances and capacitances) is interrupted, the voltage across the load does not die instantaneously but dissipates in tens of milliseconds due to residual power stored in its reactive components (combination of its circuit inductances and capacitances). The voltage and phase of the residual power in the load after interruption of the AC source are the same as the voltage and phase of the AC source at the time of interruption. A mismatch of phase and frequency of the primary AC source and the backup AC source at the time of transfer is likely to damage the backup AC source / load. For a smooth and safe transfer to take place, the phase and frequency of the backup AC source that is going to take over the load has to be synchronized with the phase and frequency of the primary AC source that is being removed from the load. A very fast transfer is desirable for sensitive loads like computers etc because a longer transfer time may crash the computer if the power supply of the computer does not have adequate "Hold Up Time" ("Hold up Time" is the duration of power interruption that can be withstood by the computer to prevent crashing. This time is usually > 20 millisecond). **In the G4 series, the phase and frequency of the internal Inverter Section is always kept synchronized with the external input from the utility / generator for fast and safe transfer.**

Benefit 5: The high power maximum charging current of the Battery Charger Section is adjustable. This allows selection of appropriate charging current based on the Ah capacity of the battery (Normally, 10% of the Ah capacity of the battery). Very high charging current for lower Ah capacity batteries will reduce the percentage of the returned capacity and will damage the battery due to overheating.

Benefit 6: The Battery Charger Section of these units is a powerful, micro-controller based, 4 Stage Charger - 80A for the 12V, 2000VA version and 70A for the 24V, 2500VA and 3500VA versions. 4 Stage Charging Algorithm is used – Bulk, Boost, Equalization and Float. (The Equalization Stage is selectable). Equalization Stage is desirable for the proper health of Wet Cell Batteries. Further, the charging voltages and currents are programmable within the ranges given below to take care of a wide range of battery types like flooded, AGM, Gel Cell, Lead Calcium, etc.:

	12V Version	24V Version
Boost (Absorption)	14 to 16V	28 to 32V
Float	13 to 15V	26 to 30V
Equalization	14 to 16V	28 to 32V
Charging current	10 to 80A (in steps of 10A)	10 to 70A (in steps of 10A)

An automatic Adaptive Charging Algorithm is used that ensures that the battery is completely charged in a safe manner for longer battery life. In this algorithm, the time the battery remains in Boost / Absorption and Equalization Stages is proportional to the time the battery remains in the Bulk Charge Stage. A battery that is deeply discharged will remain in Bulk Stage for a longer duration and will require longer time in the Boost / Absorption and Equalization Stages for complete charging. On the other hand, a battery that is almost completely charged will remain in the Bulk Stage for a shorter duration and consequently, will remain in Boost / Absorption and Equalization stages for a shorter duration. This will prevent overcharging / boiling of the battery. In other inverter chargers that execute Boost / Absorption and Equalization Stages for a fixed time of 4 to 8 Hours, a nearly fully charged battery may overcharge / boil and hence, will reduce battery life.

Benefit 7: A Battery Temperature Sensor BTS-G4 (Fig 2.4, page 8) has been provided to ensure optimum charging by modifying the charging voltages based on temperature if the battery sees very wide temperature swings. Without temperature compensation, the battery life is likely to be drastically reduced because the battery will be undercharged during

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cold conditions (will build up sulfation) or will be overcharged during hot conditions (will boil and lose excessive water) .

Benefit 8: The Battery Charger Section is able to operate in parallel with another external charging source like Solar Charge Controller / AC Charger of up to 50A capacity. The output of the external charging source is routed through the unit. Please note that Lead Acid batteries should not be charged at very high charging currents to prevent adverse effects like reduction in returned capacity, excessive surface charge, overheating, excessive pressure build up in sealed batteries (generation of Oxygen and Hydrogen will be > recombination) etc. Normally, the maximum charging current is limited to 10% of the Ah capacity of the battery unless the battery manufacturer allows higher charging current. When a battery is charged simultaneously by multiple charging sources, all the charging currents will add up and may result in very high charging current with respect to the Ah capacity of the battery. The charging current fed from the external source is measured and the charging current generated by the internal charger is automatically controlled to ensure that the net charging current fed to the battery does not exceed the net programmed Bulk Charge Current.

Benefit 9: The Inverter Section has a powerful surge power capacity - 3 times the continuous power capacity that lasts for 1 millisecond and 2 times the continuous power capacity that lasts for 100 milliseconds. The higher surge power enables use of lower powered inverter for powering of devices like air-conditioners, refrigerators, compressors, sump and well pumps etc. that require very high starting surges. Hence, lack of adequate surge capacity will demand use of a higher powered and higher priced inverter. Further, all inverters consume power for running their internal circuitry – called "No Load Power" or "Self Consumption". As the efficiency is a ratio of the output power versus the input power, the optimum efficiency is obtained at or near full rated power of the inverter. The very high surge rating of the G4 Series enables operation of this Series near its full load and hence, this Series is able to operate in the high efficiency region when powering such devices.

Benefit 10: The inverter design incorporates "Soft Start" feature with the following advantages and protections:

- When the inverter is turned on, the output voltage ramps up gradually from around 40 VAC to 120 VAC in around 350 ms. This reduces otherwise very high starting inrush current drawn by AC loads like Switched Mode Power Supplies (SMPS) and motor driven loads like fans, pumps, compressors etc. This will result in lower motor inrush current (which typically can be up to 650% of the full load current of the motor), which means lesser mechanical stresses, wear and tear and increased lifetime of the motor, coupling and fan. Additionally, the impact on the load side components is greatly reduced, meaning less likelihood of causing problematic voltage drops during starting.
- When high power load or load with high starting / inrush surge is switched ON when the inverter is running and supplying the full rated voltage, the output voltage will momentarily dip and ramp up again gradually. This will have the same effect as described above
- Reduction in output voltage and consequent reduction in output current due to high inrush surge conditions imposed by certain loads prevents the inverter from premature failure due to excessive overloading

Benefit 11: A detachable LCD Panel has been provided that can function both as a local control (fits snugly on the top of the unit) or a remote control, if desired. This saves the cost of purchasing an optional Remote Control.

Benefit 12: When an inverter is operating without any load connected to it, it requires some minimum input power from the battery to keep all the sections inside the unit alive and ready to deliver power to the AC load as soon as the load is switched on. This power is called the "No Load Power Draw" or the "Idle Power" or "Self Power Consumption" (We will call this as the "No Load Power Draw"). If the unit is on and is not powering any load, this "No Load Power Draw" is wasted as it unnecessarily drains the battery and hence, should be minimized, if possible. The "No Load Power Draw" of this unit in the Normal Mode is around 35W to 45W.

This unit has a provision to minimize this "No Load Power Draw", if required (applicable only when the unit is in "Inverter Mode"). This is achieved by enabling the "Power Save Mode". When "Power Save Mode" is enabled, the unit does not provide continuous output power but discontinuous and pulsing output power consisting of only 2 to 3 cycles of reduced 40 VAC output voltage that are made available every 2.8 seconds and are used to sense if a minimum load is present or not. As continuous power is not being supplied, the "No Load Power Draw" is reduced to less than 5W. If a load > 60W is sensed, the unit starts providing continuous normal output power (will now consume the full 35W to 45W of "No Load Power Draw" of the Normal Mode in addition to the power consumed by the load). If the load drops to < 10W, the unit once again reverts to a discontinuous output of 2 to 3 cycles of reduced voltage of 40V every 2.8 seconds and the "No Load Power Draw" once again drops to 5W.

Benefit 13: Heavy duty 80A SPDT Transfer Relay (2 x 40A relays in parallel) provides reliable handling of up to 300% surge power and Crest Factor of up to 3 for typical non-Power Factor corrected AC loads.

Benefit 14: Neutral to Ground bond switching is carried out automatically. The SPDT Transfer Relay switches both the Hot and Neutrals. AC output Neutral is bonded to Chassis Ground in Inverter Mode and is isolated in Utility/Generator Modes, ensuring Single Point Ground System for RV and marine applications to prevent possibility of electric shock and nuisance tripping of GFCIs.

Benefit 15: Higher upper DC input voltage limit of 16V (12V battery) and 32V (24V battery) is able to accommodate higher than normal operating and charging voltages for optimim charging of Lead Calcium batteries in automotive and marine applications.

Benefit 16: Complies with the following safety and EMI/EMC standards:

Safety compliance	Intertek- ETL listed – Conforms to ANSI / UL STD. 1741
	Intertek- ETL listed – Certified to CAN / CSA STD. C22.2 No. 107.1-01
	Intertek –ETL listed – Conforms to ANSI / UL STD. 458
EMI / EMC compliance	Certified to FCC Part 15(B), Class A
	Certified to ISO 7637-2 for immunity against conducted electrical transients in vehicles

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INFO

For background information on batteries and charging process, please read White Paper titled "Batteries, Chargers and Alternators" available online at: www.samlexamerica.com (Home > Support > White Papers).

All battery charging voltages are specified at battery temperature of 25˚C / 77˚F.

Principle of Operation

G4 Series is a Bi-directional Inverter / Charger with a Transfer Relay that operates either as an inverter OR as a battery charger. It uses a common Converter Section that can work in two directions – in one direction it converts external AC power to DC power to charge the batteries (Utility Mode / Generator Mode) and in the other direction, it converts the DC power from the battery to AC power (Inverter Mode). **Please note that it cannot work in both the directions at the same time (i.e. it can not work as an inverter and as a charger at the same time).**

When AC input power from utility / generator is available within the specified limits of voltage and frequency, the internal Transfer Relay passes through the AC input to the AC loads and at the same time, the AC input is fed to the Battery Charger Section.

First, the AC input voltage is stepped down by the Low Frequency Isolation Transformer and is then rectified by the 4 sets of H-Bridge Mosfets and fed to the batteries for charging. AC line current will flow only during the period when the rectified instantaneous voltage is higher than the battery voltage.

Micro-controller based PWM technique is used to accomplish 3 or 4 stage charging. During charging, the top 2 sets of H-Bridge Mosfets are kept OFF (their Body Diodes are used for conduction). The bottom 2 sets of Mosfets are switched at PWM frequency of 32 KHz. When charging starts, the current does not rise sharply, but ramps up slowly (starts at 5.3% Duty Cycle).

The Battery Charger Section of these units is a powerful, micro-controller based, 3 Stage or a 4 Stage Charger - 80A for the 12V, 2000VA version and 70A for the 24V, 2500VA and 3500VA versions.

3 Stage Charging Algorithm is used for normal day to day charging. The 3 stages are – Bulk, Boost (Absorption) and Float. The charging voltages and currents are programmable within the ranges given in the Table 4.1 to take care of a wide range of battery types like flooded, AGM, Gel Cell, Lead Calcium etc.

4 Stage Charging Algorithm is used in the Equalization Mode. Equalization Mode is activated manually when desired and is used only for Flooded or Wet Cell batteries. The 4 stages will be - Bulk, Boost (Absorption), Equalization and Float. Equalization Mode is desirable for the proper health of Wet Cell Batteries. Equalization voltage is programmable. Equalization current and Equalization time are computed automatically. *Please see Table 4.1 for details.*

Over Temperature Protection During Charging

The main Bi-directional Transformer is protected against over temperature during Battery Charging Mode by reducing the charging current to 50% if the transformer temperature ≥ 120°C. **Hence, during charging process, the internal charging current being displayed on the LCD display might drop to half the value when the temp is > 120°C. Once the transformer cools down, the charging current will resume to the full value. This cycling may repeat a number of times till the transformer temperature does not rise > 120°C.**

Automatic Interruption of Battery Charger Current In Generator Mode When Generator Frequency is Outside the Range of 45 Hz To 65 Hz

The magnitude of voltage distortion due to non-linear current draw is a function of the impedance of the AC source. Standby generators are normally rated at < 10 KVA and have much higher impedance as compared to utility transformers that may be rated at hundreds of KVA. Thus, effects of distortion will be much higher in small size generators. When powered from lower capacity standby generators, the following adverse effects are possible in a Bidirectional Inverter Charger, which may result in damage the Power Mosfets in the battery charging circuit:

- Distorted voltages will create harmonics of the fundamental frequency leading to spurious zero crossings that may be sensed as higher / lower frequency and will adversely affect the timing signals for switching of the power Mosfets.
- Voltage spikes with peak of > 200V may be generated in the secondary of the transformer feeding the Mosfets

In G4 Series, protection is provided to limit the voltage distortion to acceptable limits. When the batteries are being charged at higher charging current, the generator has to deliver proportionately higher current that produces higher frequency deviation and waveform distortion in the output waveform of the generator. ***When the frequency of the generator is fluctuating excessively and is not within the range of 45 Hz to 65 Hz, the control logic will automatically stop charging to limit voltage distortion to acceptable limits. Please see details under Section 8 - Operation, Page 51.***

Adaptive Charging Control For Complete Charging And Prevention Of Over Charging / Boiling

An automatic Adaptive Charging Algorithm is used that ensures that the battery is completely charged in a safe manner for longer battery life. In this algorithm, the time the battery remains in Boost (Absorption) and Equalization Stages is proportional to the time the battery remains in the Bulk Charge Stage. A battery that is deeply discharged will remain in Bulk Stage for a longer duration and will require longer time in the Boost

SECTION 4 | Battery Charging in G4 Series

(Absorption) and Equalization Stages for complete charging. On the other hand, a battery that is almost completely charged will remain in the Bulk Stage for a shorter duration and consequently, will remain in Boost (Absorption) and Equalization stages for a shorter duration. This will prevent overcharging / boiling of the battery. In other inverter chargers that execute Boost (Absorption) and Equalization Stages for a fixed time of 4 to 8 Hours, a nearly fully charged battery may overcharge / boil and hence, will reduce battery life.

Parallel Charging Of Batteries Through External Charger

The Battery Charger Section is able to operate in parallel with another external charging source like Solar Charge Controller / AC Charger of up to 50A capacity. The output of the external charging source is routed through the unit (Connectors 3, 4 in Fig 2.1 on page 8). Maximum charging current from the external charging source is limited to 50A This limit should not be exceeded!

Please note that Lead Acid batteries should not be charged at very high charging currents to prevent adverse effects like reduction in returned capacity, excessive surface charge, overheating, excessive pressure build up in sealed batteries (generation of Oxygen and Hydrogen will be > recombination) etc. Normally, the maximum charging current is limited to 10% of the Ah capacity of the battery unless the battery manufacturer allows higher charging current. When a battery is charged simultaneously by multiple charging sources, all the charging currents will add up and may result in very high charging current with respect to the Ah capacity of the battery.

The charging current fed from the external source is measured and the charging current generated by the internal charger is automatically controlled to ensure that the net charging current fed to the battery does not exceed the net programmed Bulk Charge Current.

Battery Temperature Sensor

A Battery Temperature Sensor Model BTS-G4 has been provided (Fig 2.4, page 8). It comes with 10' cable. Connect the ring terminal end (houses the sensor) on the battery Positive post. Connect the 6P2C plug to the Temperature Sensor connector (#6, Fig. 2.1 on page 8). The Temperature Sensor is used to ensure optimum charging by modifying the charging voltages based on temperature if the battery sees very wide temperature swings. Temperature compensation will be carried out over a temperature range of – 20°C to + 50°C. The sensor has a Voltage Coefficient of -4 mV/°C/cell that has been programmed as default value (see setting SCREEN 7 on page 41).

3 Stage Charging Profile: Bulk, Boost (Absorption) & Float For Normal Charging

Normal day to day charging is performed in a 3 stage cycle—BULK, BOOST (Absorption), AND FLOAT— to provide rapid and complete charge cycles without undue battery gassing. Please see Table 4.1 for details of programmable settings.

Fig. 4.1 shows the voltage and current charging curves with respect to time and different charge stages.

***NOTE:** An optional, manually activated 4 Stage Charging including the 4th Equalization Stage is required to be carried out only on flooded / wet cell batteries. The charging profile in this stage is discussed separately under "4 Stage Charging Profile in manually activated Equalization Mode (page 17).*"

Bulk Charge Stage

In the first stage, known as the Bulk Charge Stage, the charger delivers the maximum charge current "Io" that has been set through the "Settings Menu" (SCREEN 6, page 41). This current is delivered to the batteries until the battery voltage approaches its Gassing Voltage (Boost or Absorption Voltage)—typically around 14.4 volts for 12 volt batteries and 28.8 volts for 24 volt batteries (again, this voltage can vary based upon the desired values programmed through the "Settings Menu" (SCREEN 4, page 41). The Bulk Charge Stage restores about 75% of the battery's charge. The Gassing Voltage is the voltage at which the electrolyte in the battery begins to break down into Hydrogen and Oxygen gases. Under normal circumstances, a battery should not be charged at a voltage above its Gassing Voltage (except in the manually selected Equalization Stage) since this will cause the battery to lose electrolyte and dry out over time.

TABLE 4.1: BATTERY CHARGING PARAMETERS

Parameter	12V Version		24V Version	
	Programmable Range	Default	Programmable Range	Default
Bulk Charging Current	10 to 80A (Steps of 10A)	10A	10 to 70A (Steps of 10A)	10A
Boost (Absorption) Voltage	14 to 16 VDC	14.4 VDC	28 to 32 VDC	28.8 VDC
Time in Boost (Absorption) Stage	Automatic – will be computed based on the time the battery remains in Bulk Mode Minimum: 1 Hour Maximum: 12 Hours			
Float Voltage	13 to 15 VDC	13.5 VDC	26 to 30 VDC	27 VDC
Equalization Voltage	14 to 16 VDC	15.3 VDC	28 to 32 VDC	30.6 VDC
Equalization Time	Automatic – Will be computed based on the time the battery remains in Bulk Stage			
Equalization Current	Automatic - Will be computed at 50% of the set Bulk Charge Current			

SECTION 4 | Battery Charging in G4 Series

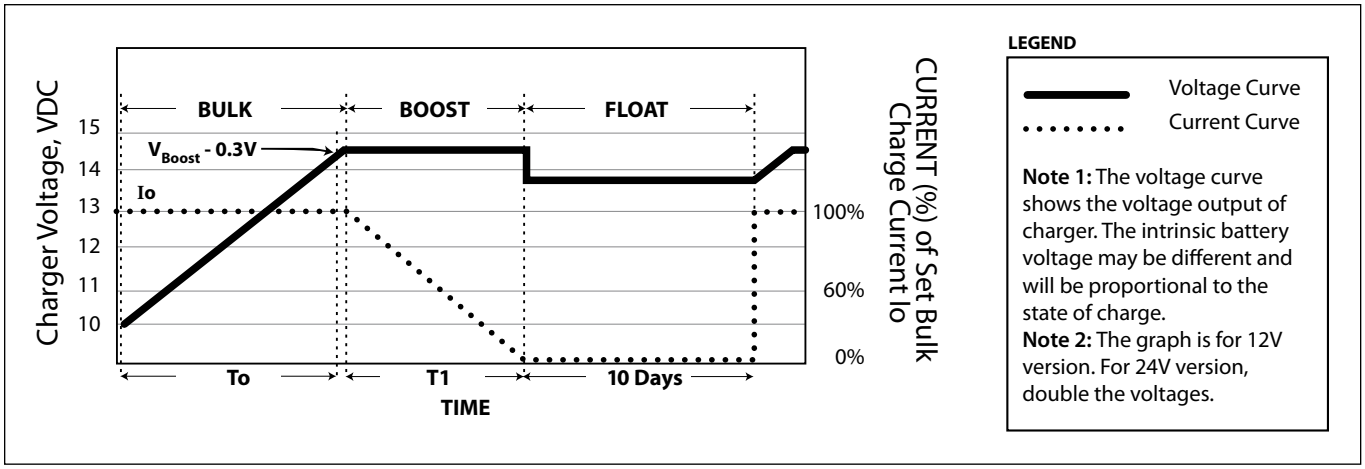

Fig. 4.1. Charging Curve for Normal 3 Stage Charging

The value of the Bulk Charge Current "Io" depends upon the total Ampere Hour (Ah) capacity of the battery or bank of batteries. A battery should never be charged at very high charging current as very high rate of charging will not return the full 100 percent capacity as the Gassing Voltage rises with higher charging current. As a general Rule of Thumb, the Bulk Charging Current "Io" should be limited to 10% of the Ah capacity of the battery. Higher charging current may be used if permitted by the battery manufacturer.

The Bulk Charge Current "Io" can be programmed with the help of the "Setting Menu" (SCREEN 6, page 41) as follows:

	12V Version		24V Version	
Parameter	Programmable Range	Default	Programmable Range	Default
Bulk Charging Current, Io	10 to 80A (Steps of 10A)	10A	10 to 70A (Steps of 10A)	10A

INFO

Please note that if an external charging source is also used to charge the batteries at the same time in parallel with the internal AC charger of the unit, the charging current of the internal AC charger will be controlled so that the total charging current of the external charger and the internal charger is = the programmed charging current.

For example, if the programmed charging current is say 60A and the charging current of the external charger is 30A, the internal AC charger will output only 30A (Programmed setting of 60A – external charging current of 30A = 30A). Similarly, if the programmed setting is say 30A and the external charger is 50A, the internal AC charger will not provide any charging.

When the unit enters the AC bypass Mode, it starts working as a battery charger and the charger will run at full programmed Bulk Charge Current until the charger reaches the programmed Boost Voltage.

As part of the Adaptive Charging Algorithm, a software timer will measure the time taken from the instant the unit enters the AC Bypass Mode till the instant the battery voltage reaches 0.3V below the programmed Boost Voltage, then registers this time as Bulk Charge Time To and computes the Absorption Time T1 as 10 times the Bulk Charge Time To in the internal "T1 Timer" i.e. T1 = To x 10. The "T1 Timer" is used to determine the time the charging will take place in the next Boost (Absorption) Stage.

Boost (Absorption) Stage

During the Boost (Absorption) Stage, the charging voltage is held constant near the Gassing Voltage to ensure that the battery is further charged to the full capacity without overcharging. The Boost (Absorption) Stage restores the remaining 25% of the battery's charge. The time the charger remains in the Boost (Absorption) Stage is proportional to the depth of discharge of the battery. When the battery is more discharged, it will take longer time in the Bulk Charge Stage to reach the Gassing Voltage. As a part of the Adaptive Charging Algorithm, the "T1 Timer" (explained above) computes the time the charging takes place in this stage.

- *The "T1 Timer" has minimum time of 1 hour and a maximum time of 12 hours.*
- When the T1 Timer runs out, the charger will enter the next Float Stage.
- The desired Boost (Absorption) Voltage can be programmed through the "Settings Menu" (SCREEN 4, page 41) as follows:

SECTION 4 | Battery Charging in G4 Series

Parameter	12V Version		24V Version	
	Programmable Range	Default	Programmable Range	Default
Boost (Absorption) Voltage	14 to 16 VDC	14.4 VDC	28 to 32 VDC	28.8 VDC

Float Stage

The Float Stage is a maintenance stage in which the output voltage is reduced to a lower level, typically about 13.5 volts, (27 volts for 24V models) to maintain the battery's charge without losing electrolyte through gassing.

The desired Float Voltage can be programmed through the "Settings Menu" (SCREEN 5, page 41) as follows:

Parameter	12V Version		24V Version	
	Programmable Range	Default	Programmable Range	Default
Float Voltage	13 to 15 VDC	13.5 VDC	26 to 30 VDC	27 VDC

Resetting of Charging Cycle

The charging cycle will be reset as follows:

- If the AC is reconnected or the battery voltage drops below 12 VDC / 24 VDC.
- If the charger remains in the Float Mode for 10 days.

4 Stage Charging Profile In Manually Activated Equalization Mode

For details of equialization procedure, please see pages 53 - 55 under Section 8 - Operation.

4 Stage Battery Charging Cycle is used in the Equalization Mode. Equalization Mode is activated manually when desired because equalization of the batteries is carried out periodically - once per month for battery under heavy duty service and every two to four months for battery under light duty service. As equalization is a deliberate overcharge of the battery for a specified time period, equalizing your flooded / wet cell batteries will reduce sulfation, stir up the electrolyte to remove stratification, equalize voltages of individual cells and thus, help reach and maintain the peak capacity of the battery.

Please read about the necessity and details of equalizing batteries under White Paper titled "Batteries, Chargers and Alternators," available online at www.samlexamerica.com (Home > Support > White Papers).

The 4 stages of the cycle will be - Bulk, Boost (Absorption), Float and Equalization. Equalization Mode is desirable for the proper health of Wet Cell Batteries. Equalization voltage is programmable. Equalization current and Equalization time are computed automatically. Please see Table 4.1, page 15 for details of programmable settings.

CAUTION!

Equalization Mode should be performed only on vented, flooded (non-sealed or "wet") batteries and not on the sealed AGM / Gel Cell batteries and only as often as recommended by the battery manufacturer.

ATTENTION! La mode d'égalisation devrait être faite sur des batteries ventillées, inondées (batteries non-scellées ou «mouillées») et pas sur des batteries scellées (AGM) ou cellulles gelées et, aussi souvent que les recommandations du fabricant.

Fig 4.2 (page 18) shows the voltage and current curves during the 4 stages of charging in this mode

When Equalization is started manually, the charger will first execute Bulk Stage followed by Boost (Absorption) Stage. On completion of Boost (Absorption) Stage, the charger will execute Equalization Stage. After completion of Equalization Stage, the charger will enter Float Stage. The stage transitions will thus be: Bulk Stage (Constant Current) ⟶ Boost (Absorption) stage (Constant Voltage) ⟶ Equalization Stage (Constant Voltage) ⟶ Float Stage (Constant Voltage).

As part of the **Adaptive Charging Algorithm**, the charging profile in the Equalization Stage is based on the time To which is the time the charger remains in the initial Bulk Stage. The charger will remain in the initial Bulk Stage for a longer duration when the battery is deeply discharged and for a shorter duration if the battery has a shallow discharge.

CAUTION!

For effective equalization to take place, it is desirable that the batteries undergo a longer Bulk Stage applicable to the deeply discharged condition of the battery. Hence:

- **Please ensure that before the batteries are equalized, they should be deeply discharged to ≥ 80% capacity. The Standing Voltage (Terminal Voltage after disconnection charging source[s] and load[s] for at least 3 hours) at ≥ 80% discharge will be:**
  - **12V Battery: Around 11.7V**
  - **24V Battery: Around 23.4V**
- **Do not equalize partially or fully charged batteries**

SECTION 4 | Battery Charging in G4 Series

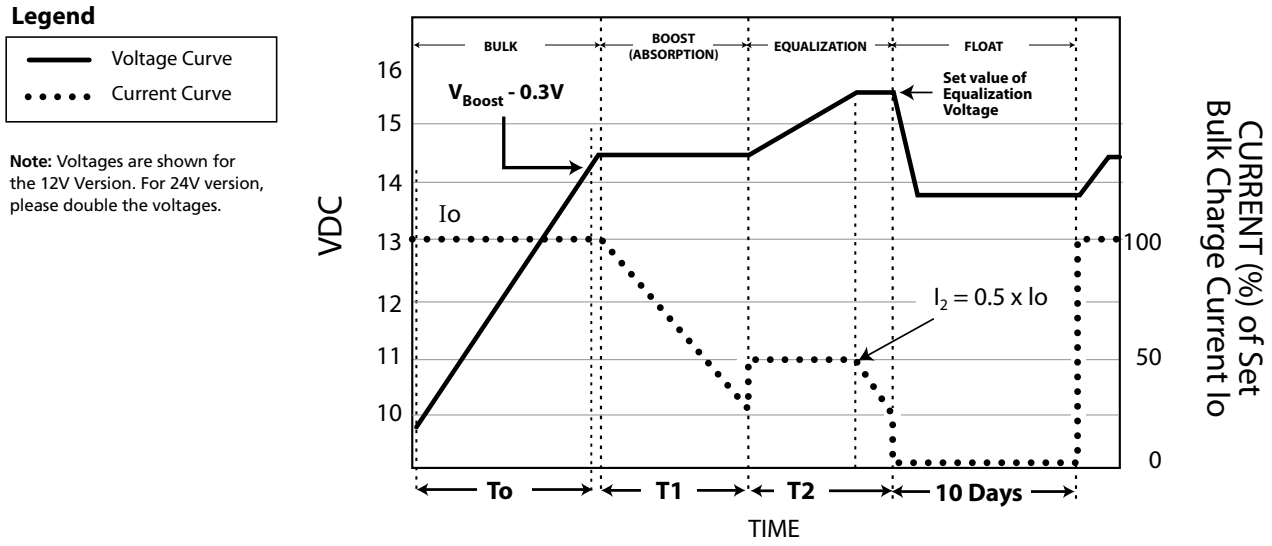

Fig. 4.2. Charging Curve for 4 Stage Charging in Equalization Mode

ATTENTION!

Pour une égalisation efficace, il faut que les batteries subissent à une étape majeure plus long en fonction de la condition déchargée de la batterie. Alors:

Veuillez assurer que les batteries sont profondément déchargées (à 80% ou plus de sa capacité), avant de les égaliser. La tension constante (la tension de la borne après avoir déconnecter toutes sources de charge pour un minimum de 3 heures) quand elles sont déchargées à 80% ou plus, serait:

- Une batterie de 12V: Environ 11,7V
- Une batterie de 24V: Environ 23,4V

N'égalisez pas des batteries qui sont partiellement ou complètement chargées

The logic will be as follows:

- During the Bulk Stage, the charger will charge at the programmed Bulk Charge Current "Io" **(See Setting Menu, SCREEN 6, page 41).**
- A Software Timer is used to measure the time taken from the time the unit transfers to the Utility / Generator Mode until the battery charger reaches 0.3V below the Boost (Absorption) Voltage, then registered this time as time To. The following times are computed based on the time To:
- Boost (Absorption) Time T1 = To x 0.5
- Equalization Time T2 is then computed based on the following logic:
  T2 = T1 + 1 hr = 0.5 To + 1 hr ; if T1 < 2 hrs
  T2 = T1 + 2 hrs = 0.5 To + 2 hrs ; if 2 < T1 < 4 hrs
  T2 = T1 + 4 hrs = 0.5 To + 4 hrs ; if T1 > 4 hrs
- When the battery reaches the programmed Boost (Absorption) Voltage **(See Setting Menu, SCREEN 4, page 41)**, it transitions to the Boost (Absorption) Stage and remains in this stage for the computed time T1.
- At the end of Boost (Absorption) Stage, it transitions to the programmed Equalization Voltage **(see Setting Menu SCREEN 8, page 42)**.
  It remains in this stage for the computed time T2.
- The equalization current "I_2" is normally 5% of the Ah capacity of the battery. This current is indirectly computed from the set Bulk Charge Current. **As recommended under the Setting Mode for the Bulk Charge Current, the Bulk Charge Current "Io" is expected to be set at 10% of the Ah capacity of the battery.** Hence, the Equalization current "I_2" will be automatically computed at 50% of the set Bulk Charge Current "Io" which will effectively amount to 5% of the Ah capacity of the battery. For example, the Equalization Current "I_2" for a 200 Ah capacity battery will be 10 A. The Bulk Charge current "Io" for a 200 Ah capacity at 10% will be set at 20 A. The firmware will compute the Equalization Current "I_2" at 50% of 20 A (i.e. 10 A).
- At the end of Equalization Stage, the charger transitions to the programmed Float Voltage **(See Setting Menu, SCREEN 5, page 41).**

Resetting of Charging Cycle

The charging cycle will be reset as follows:

- If the AC is reconnected or the battery voltage drops below 12 VDC / 24 VDC.
- If the charger remains in the Float Mode for 10 days.

SECTION 5 | Installation

WARNING!

Before commencing installation, please read the safety instructions explained in the Section 1 titled "Safety Instructions."

1. It is recommended that the installation should be undertaken by a qualified, licensed / certified electrician.
2. Various recommendations made in this manual on installation will be superseded by the National / Local Electrical Codes related to the location of the unit and the specific application. A few examples of National Codes are given below:
   - National Electrical Code (NEC) - USA
   - Canadian Electrical Code (CEC) - Canada
   - Recreation Vehicle Industry Association (RVIA) Standards for installation of 12 VDC and 120 VAC Systems
3. The wiring methods should comply with the National Electrical Code, ANSI/NFPA 70.

WARNING!

1. This equipment employs components that tend to produce arcs or sparks: To prevent fire or explosion, do not install in compartments containing batteries or flammable materials.
2. Risk of electric shock: Use only the ground-fault circuit-interrupter [receptacle(s) or circuit breaker(s)] specified in the installation and operating instructions manual supplied with this inverter. Other types may fail to operate properly when connected to this inverter equipment.
3. Do not install on or over combustible surfaces.
4. Do not touch non-insulated portions of battery terminals.
5. Reverse battery hook up will damage the inverter.
6. For continued protection against risk of fire or electric shock replace only with same type and ratings of fuse.

   Maximum external battery fuse ratings (refer to Table 5.1, page 27):
   - 32VDC / 195A for model G4-2524A
   - 32VDC / 290A for model G4-3524A
   - 32VDC / 320A for model G4-2012A
7. Grounding: The grounding symbol below is used for identifying only the field wiring equipment-grounding terminal. However, this symbol is usable with the circle omitted for identifying various points within the unit that are bonded to ground.

   Grounding Symbol / *Défaut à la terre*

CAUTION!

1. To reduce risk of electric shock and fire:
   - Both AC and DC voltage sources are terminated inside this equipment. Each circuit must be individually disconnected before servicing.
   - Do not connect to a circuit operating at more than 150 Volts to Ground.
   - Do not connect to an AC load center (circuit breaker panel) having multi wire branch circuits connected.
   - Do not remove cover. No user serviceable parts inside. Refer servicing to qualified service personnel. Do not expose to rain or spray.
   - Do not cover or obstruct ventilation openings. Do not mount in zero-clearance compartment. Overheating may result.
2. Provided with integral protection against overloads.
3. Hot Surfaces: To prevent burns, do not touch. The unit should be installed so it is not likely to come into contact with people.
4. Use 90˚C / 194˚F copper conductors only for supply connectors.
5. For indoors use only.
6. Tightening torques to be applied to the wiring terminals are given in the Table below:

Battery Input Connectors	External Charger Input Connectors	AC Input & Output Connectors
70 Kgf.cm (5.0 lbf.ft)	35 Kgf.cm (2.5 lbf.ft)	7 to 12 Kgf.cm (0.5 to 0.9 lbf.ft)

7. Maximum sizes of wires to be used for field connectors are specified in the Table given below (to meet conductor size and bending space requirements under Sections 16.1.3, 17.2 and 63.27 of UL-1701):

	Size of wire for battery input side	Size of wire for external charger input side	Size of wire for AC input & output sides
G4-2012A	MCM/kcmil 300	AWG #4	AWG #8
G4-2524A	AWG #2/0	AWG #4	AWG #8
G4-3524A	MCM/kcmil 250	AWG #4	AWG #6

ATTENTION!

Avant de faire une installation, veuillez lire les « consignes de sécurité » (Safety Instructions) à la section 1.

1. *On recommande que l'installation soit faite par un(e) électricien(ne) certifié(e).*
2. *Il y a plusieurs consignes trouvées dans ce guide qui ne sont pas toujours appliquables si une norme nationale ou locale en prend place, en relation par example à l'endroit d'installation ou à l'usage de l'appareil. Quelques exemples sont écrits ci-dessous:*
   - *La Norme Nationale Électrique (NEC)- Les ÉU*
   - *Le Code Canadien Électrique (CCE)- le Canada*
   - *L'Association de l'Industrie des Véhicules Récréatifs (RVIA) - Les Standards pour l'installation des systèmes de 12 VCC et 120 VCA*
3. *Les méthodes de câblage devraient conformer avec la norme nationale électrique ANSI/NFPA 70*

SECTION 5 | Installation

ATTENTION!

1. *Cet équipement se sert des composants qui ont tendance à produire des arcs électriques ou des étincelles: Afin de prévenir une explosion ou un incendie, n'installer pas dans les compartiments qui contiennent des batteries ou des matériaux combustibles.*
2. ***Une risque de décharge électrique:** Utiliser seulement le disjoncteur-défaut à la terre [réceptacle(s) ou disjoncteur(s)] énumèré dans le guide des instructions d'installation et fonctionnement qui est fourni avec l'onduleur. Des autres disjonteurs pourrait échouer quand ils sont branchés à l'onduleur.*
3. *N'installez pas sur ou au-dessus des surfaces combustibles*
4. *Ne toucherz pas les parties des bornes de batterie qui sont pas isolées.*
5. *Si les batteries sont branchées à l'envers, ça va endommager l'onduleur.*
6. *Si ça devient nécessaire de remplacer les fusibles, remplacer les seulement avec le même classement que ceux du départ, afin de réduire les risques d'incendie ou de décharge électrique.*

   Les classements maximales de fusible externe de batterie (Voir la Table 5,1, à la page 27):
   - *32 VCC / 195A pour le modèle G4-2524A*
   - *32 VCC / 290A pour le modèle G4-3524A*
   - *32 VCC / 320A pour le modèle G4-2012A*
7. ***Le défaut à la terre:** Le symbole du défaut à la terre est utilisé spécifiquement pour indiquer l'équipement de câblage-borne à la terre.Cependant, si cet symbole apparaît sans un cercle, il est utilisé pour identifier des parties de l'équipement qui sont liées à la terre.*

ATTENTION!

1. ***Pour réduire les risques de décharge électrique et d'incendie:***
   - *Les deux sources de tension CC et CA terminent dans l'équipement. Il faut déconnecter chaque circuit avant de l'utiliser*
   - *Ne connectez pas à un circuit qui fonctionne à plus que 150V à la terre.*
   - *Ne connectez pas à un centre de charge CA (panneau de disjonction) ayant des circuits multi-fil qui sont connectés*
   - *Enlevez pas la couverture. Les parties doivent être réparées par un(e) professionel(le) certifié(e) pas par l'utilisateur. Ne l'exposez pas à l'eau*
   - *Pour éviter la surchauffe, ne couvrez ni bloquez les ouvertures de ventilation. Ne le montez pas dans un compartiment qui n'est pas bien dégagé.*
2. *Fourni avec une protection intégrale contre des surcharges*
3. *Des Surfaces Chaudes: Pour prévenir des brûlures, ne le touchez pas.*
4. *Utiliser seulement des conducteurs en cuivre de 90˚C / 194˚F pour des connexions d'alimentation.*
5. *À utiliser exclusivement à l'intérieure*
6. *Les torques de serrage qui sont appliquées aux bornes de serrage sont montrées dans la table ci-dessous:*

Connecteurs d'entrée à la batterie	*Connecteurs d'entrée au chargeur externe*	*Connecteursd'entrée et sortie CA*
70 Kgf.cm	*35 Kgf.cm*	*7 to 12 Kgf.cm*
(5.0 lbf.ft)	*(2.5 lbf.ft)*	*(0.5 to 0.9 lbf.ft)*

7. *La taille maximale du câblage est spécifiée dans la table ci-dessous (pour que la taille du conducteur et l'espace (pour fléchir) soient conformes aux normes des sections 16.1.3 , 17.2 et 63.27 de Ul-1701:*

	Taille du câblage pour le côté d'entrée de la batterie	***Taille du câblage pour le côté d'entrée du chargeur externe***	***Taille du câblage pour les côtés d'entrée et sortie CA***
G4-2012A	*MCM/kcmil 300*	*AWG #4*	*AWG #8*
G4-2524A	*AWG #2/0*	*AWG #4*	*AWG #8*
G4-3524A	*MCM/kcmil 250*	*AWG #4*	*AWG #6*

Location Of Installation

Please ensure that the following requirements are met:

Cool: Heat is the worst enemy of electronic equipment. Hence, please ensure that the unit is installed in a cool area that is also protected against heating effects of direct exposure to the sun or to the heat generated by other adjacent heat generating devices.

Well Ventilated: The unit is cooled by convection and by forced air-cooling by 2 temperature / load controlled fans. Please see details under heading "Cooling by Temperature/Load Controlled Fans" on page 11. To avoid shut down of the inverter due to over temperature, do not cover or block these ventilation openings or install the unit in an area with limited airflow. If installed in an enclosure, fresh air intake openings must be provided directly opposite to the intake vents and exhaust openings directly opposite to the discharge vents. This will allow cool air from the outside to flow into the unit and heated air to exit the unit and out of the enclosure.

Dry: There should be no risk of condensation, water or any other liquid that can enter or fall on the unit. The internal Printed Circuit Boards (PCB) are conformal coated with a thin coating of lacquer to provide basic safety against harmful effects of corrosive environment and short circuiting due to condensation.

SECTION 5 | Installation

Clean: The area should be free of dust and fumes. Ensure that there are no insects or rodents that may enter or block the ventilation openings.

Protection against fire hazard: The unit is not ignition protected and should not be located under any circumstance in an area that contains highly flammable liquids like gasoline or propane in an engine compartment with gasoline-fueled engines. Do not keep any flammable / combustible material (i.e., paper, cloth, plastic, etc.) near the unit that may be ignited by heat, sparks or flames.

Closeness to the battery bank: Locate the unit as close to the battery bank as possible to prevent excessive voltage drop in the battery cables and consequent power loss and reduced efficiency. However, the unit should not be installed in the same compartment as the batteries or mounted where it will be exposed to corrosive acid fumes and flammable Oxygen and Hydrogen gases produced when the batteries are charged. The corrosive fumes will corrode and damage the unit and if the gases are not ventilated and allowed to collect, they could ignite and cause an explosion.

Accessibility: Do not block access to the Control Panel. Also, allow enough room to access the AC and DC wiring terminals and connections as they will need to be checked and tighten periodically. The unit should be installed so it is not likely to come into contact with people.

Preventing Radio Frequency Interference (RFI): The unit uses high power switching circuits that generate RFI. This RFI is limited to FCC standard FCC Part 15(B), Class A. Locate any electronic equipment susceptible to radio frequency and electromagnetic interference as far away from the inverter as possible.

Mounting Of The Unit

Overall dimensions: The overall dimensions and the location of the mounting holes are shown in Fig. 5.1.

Mounting Orientation: The unit has openings for cooling and ventilation. It has to be mounted in such a manner so that small objects should not be able to fall easily into the unit from these openings and cause electrical / mechanical damage. Safety requirements limit the size of openings that have a possibility of small objects passing through when dropped from top.

CAUTION! Space and ventilation requirements must be met. Ensure there is OVER 200 mm clear space surrounding the inverter for ventilation.

ATTENTION! Il faut suivre les exigences d'espace et de ventilation. Assurer qu'il y a PLUS QUE 200 mm d'espace DÉGAGÉ entourant l'onduleur pour faciliter la ventilation.

Also, if the internal components overheat and melt / dislodge due to a catastrophic failure, the melted / hot dislodged portions should not be able to fall out of the unit on to a combustible material and cause a fire hazard. Safety requirements limit the size of holes / permit appropriately sized wire mesh for this protection.

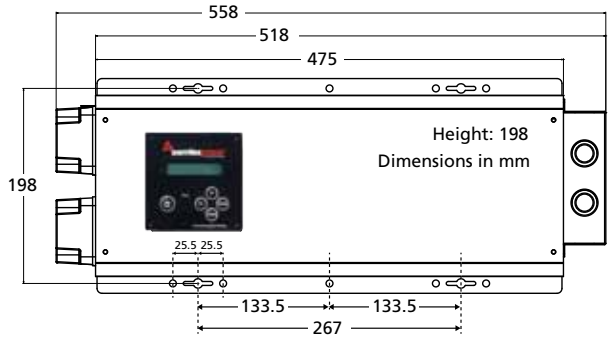

Fig. 5.1 Mounting Dimensions

In order to meet the regulatory safety requirements, the mounting has to satisfy the following requirements:

- Mount on a non-combustible material
- The mounting surface should be able to support a weight of at least 60 Kg / 132 lbs.
- Mount horizontally on a horizontal surface (e.g. table top or a shelf). Please see Fig. 5.2.

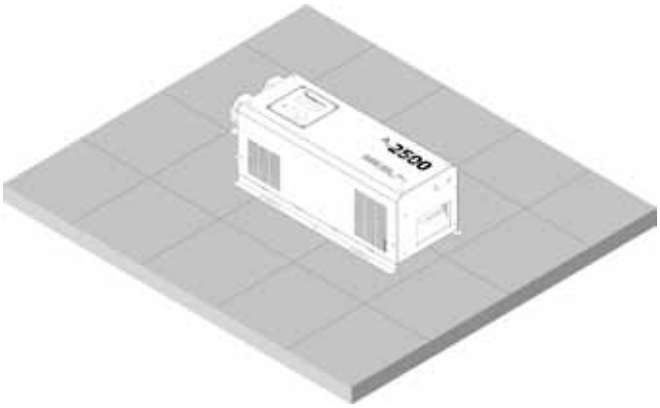

Fig 5.2 Mounting Arrangement: Horizontally On Horizontal Surface

- Mount horizontally on a vertical surface: The unit can be mounted on a vertical surface (like a wall) with the fan axis horizontal and the DC input terminals facing left. Please see Fig. 5.3 (page 22).

SECTION 5 | Installation

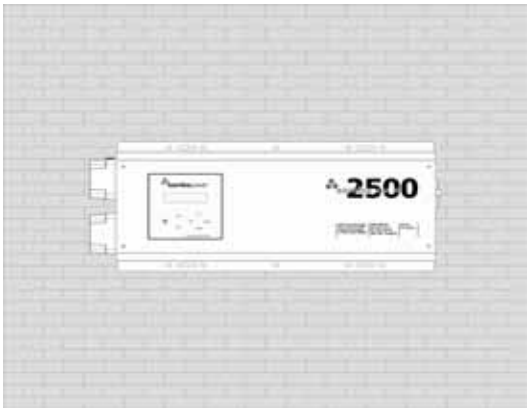

Fig 5.3: Mounting Arrangement 1: On Vertical Surface

- Mount vertically on a vertical surface: The unit can be mounted on a vertical surface (like a wall) with the DC terminals facing up. See Fig. 5.4.

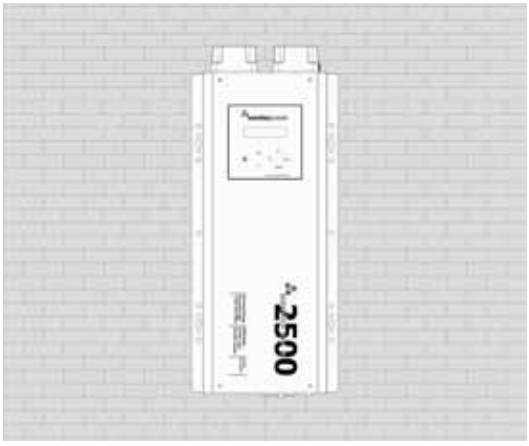

Fig 5.4: Mounting Arrangement 2: On Vertical Surface

INSTALLING BATTERIES - SERIES AND PARALLEL CONNECTION

Batteries are normally available in voltages of 2V, 6V and 12V and with different Ah capacities. A number of individual batteries can be connected in series and in parallel to form a bank of batteries with the desired increased voltage and capacity.

Series connection

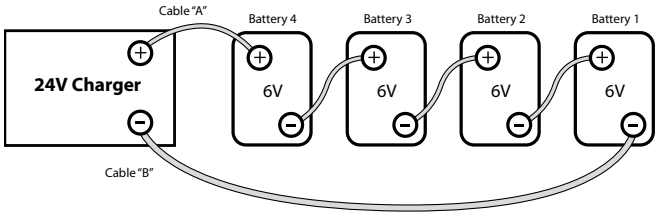

Fig 5.5 Series connection

When two or more batteries are connected in series, their voltages add up but their Ah capacity remains the same. Fig. 5.5 Above shows 4 pieces of 6V, 200 Ah batteries connected in series to form a battery bank of 24V with a capacity of 200 Ah. The Positive terminal of battery 4 becomes the Positive terminal of the 24V bank. The Negative terminal of battery 4 is connected to the Positive terminal of battery 3. The Negative terminal of battery 3 is connected to the Positive terminal of battery 2. The Negative terminal of battery 2 is connected to the Positive terminal of battery 1. The Negative terminal of battery 1 becomes the Negative terminal of the 24V battery bank.

Parallel connection

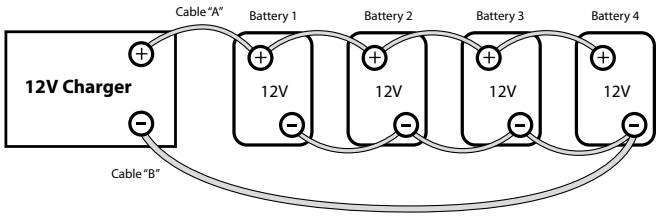

Fig 5.6 Parallel connection

When two or more batteries are connected in parallel, their voltage remains the same but their Ah capacities add up. Fig. 5.6 Above shows 4 pieces of 12V, 100 Ah batteries connected in parallel to form a battery bank of 12V with a capacity of 400 Ah. The four Positive terminals of batteries 1 to 4 are paralleled (connected together) and this common Positive connection becomes the Positive terminal of the 12V bank. Similarly, the four Negative terminals of batteries 1 to 4 are paralleled (connected together) and this common Negative connection becomes the Negative terminal of the 12V battery bank.

Series – Parallel Connection

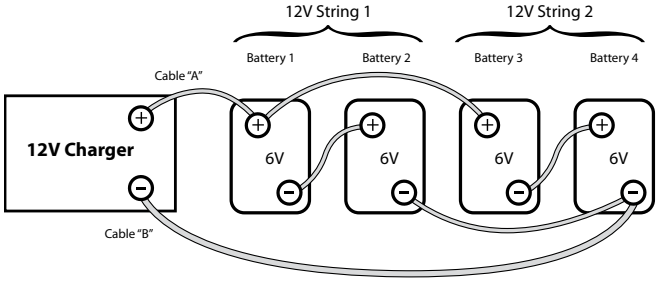

Fig. 5.7 Series-Parallel Connection

SECTION 5 | Installation

Figure 5.7 (page 22) shows a series – parallel connection consisting of four 6V, 200 Ah batteries to form a 12V, 400 Ah battery bank. Two 6V, 200 Ah batteries, Batteries 1 and 2 are connected in series to form a 12V, 200 Ah battery (String 1). Similarly, two 6V, 200 Ah batteries, Batteries 3 and 4 are connected in series to form a 12V, 200 Ah battery (String 2). These two 12V, 200 Ah Strings 1 and 2 are connected in parallel to form a 12V, 400 Ah bank.

CAUTION!

When 2 or more batteries / battery strings are connected in parallel and are then connected to a charger (See Figs 5.6 and 5.7, page 22), attention should be paid to the manner in which the charger is connected to the battery bank. Please ensure that if the Positive output cable of the battery charger (Cable "A") is connected to the Positive battery post of the first battery (Battery 1 in Fig 5.6) or to the Positive battery post of the first battery string (Battery 1 of String 1 in Fig. 5.7), then the Negative output cable of the battery charger (Cable "B") should be connected to the Negative battery post of the last battery (Battery 4 as in Fig. 5.6) or to the Negative Post of the last battery string (Battery 4 of Battery String 2 as in Fig. 5.7).

This connection ensures the following:

- The resistances of the interconnecting cables will be balanced.
- All the individual batteries / battery strings will see the same series resistance.
- All the individual batteries will charge at the same charging current and thus, will be charged to the same state at the same time.
- None of the batteries will see an overcharge condition.

If the Positive output cable of the battery charger (Cable "A") is connected to the Positive battery post of the first battery (Battery 1 in Fig. 5.6) or to the Positive battery post of the first battery string (Battery1 of String 1 in Fig. 5.7), and the Negative output cable of the battery charger (Cable "B") is connected to the Negative battery post of the first battery (Battery 1 as in Fig. 5.6) or to the Negative Post of the first battery string (Battery 1 of Battery String 1 as in Fig 5.7), the following abnormal conditions will result:

- The resistances of the connecting cables will not be balanced.
- The individual batteries will see different series resistances.
- All the individual batteries will be charged at different charging current and thus, will reach fully charged state at different times.
- The battery with lower series resistance will take shorter time to charge as compared to the battery which sees higher series resistance and hence, will experience over charging and its life will be reduced.

ATTENTION!

Quand il y a 2 batteries/fils de batterie ou plus qui sont liés en parallèle et branché à la fois, à un chargeur (Voir Figs. 5.6 et 5.7 à la page 22), il faut faire attention à la manière dont le chargeur est branché à la banque de batterie. Veuillez assurer que le câble positif de sortie du chargeur de batterie (Câble A) est lié à la borne positive de la première batterie (La batterie 1 dans la Fig. 5.6) ou à la borne positive de batterie qui est liée au premier fil (Le fil 1 et la batterie 1, Fig 5.7), et puis le câble négatif de sortie du chargeur de batterie (Câble B) est lié à la borne négative de la dernière batterie (La Batterie 4 dans la Fig. 5.6) ou à la borne négative de batterie qui est liée au dernier fil (Le fil 2 et La batterie 4 dans la Fig. 5.7).

Cette connexion assure la suivante:

- *Les résistances des câbles interconnectés seront équilibrées*
- *Tous les batteries/ fils de batterie dans la série auront la même résistance*
- *Toutes les batteries individuelles vont recharger au même courant, ainsi elles seront rechargées à l'état pareille, au même temps*
- *Aucune des batteries auront une condition de surcharge.*

Si le câble positif de sortie du chargeur de batterie (Câble A) est lié à la borne positive de la première batterie (La batterie 1 dans la Fig. 5.6) ou à la borne positive de batterie qui est liée au premier fil (Le fil 1 et La Batterie 1, Fig 5.7), et puis le câble négatif de sortie du chargeur de batterie (Câble B) est lié à la borne négative de la première batterie (La batterie 1 dans la Fig. 5.6) ou à la borne négative de batterie qui est liée au premier fil (Le fil 1 de La Batterie 1 dans la Fig. 5.7), les conditions anormales résulteront:

- *Les résistances des câbles interconnectés seront pas équilibrées*
- *Tous les batteries/ fils de batterie dans la série n'auront pas la même résistance*
- *Toutes les batteries individuelles vont recharger à des courants différentes, ainsi elles atteindront un état de rechargement complèt mais en décalage.*
- *La batterie ayant le moins de résistance dans la série prendrait moins de temps pour être rechargée comparé aux autres batteries. Alors elle serait surchargée et, en conséquence aurait une vie plus courte.*

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DC Side Connections

1. Battery Positive (+) Input Connector – M8 nut & bolt (RED Protection Cover is not shown)
2. Battery Negative (-) Input Connector – M8 nut & bolt (Black Protection Cover is not shown)
3. External Charger (+) Input Connector – M8 Thumb Nut and bolt
4. External Charger (-) Input Connector - M8 Thumb Nut and bolt
5. DC side Ground Connector – Wire size AWG # 4-6. Set screw 5 / 16" – 24 UNF
6. 6P2C Modular Connector for Temperature Sensor
7. 8P8C Modular Connector for Remote
8. Cooling Fan 1 (Cooling Fan 2 is inside the unit and is not visible)

NOTE:
Cooling Fan 1 (8) sucks cool air from outside and discharges into the unit.

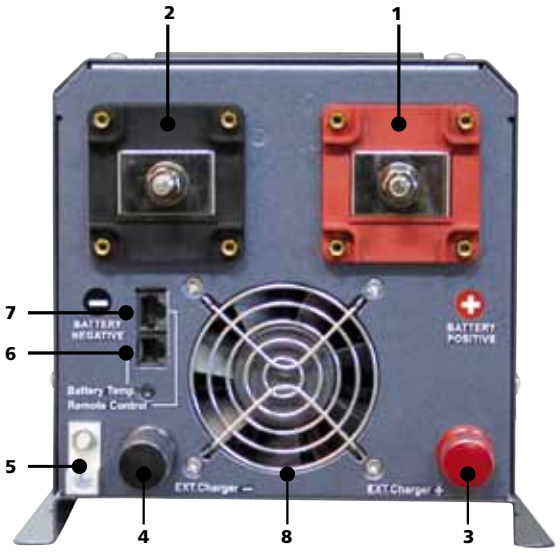

Fig. 5.8 DC Side Layout & Connections

DC Side Connections

The following DC side connections are required to be made (see Fig 5.8):

- Deep cycle batteries are connected to the battery input terminals (1) and (2) as shown below. The terminals are provided with protective covers – RED for Positive and BLACK for Negative. Fit these covers once connections have been made. **For details on sizing and charging of batteries, please read on-line White Paper titled "Batteries, Chargers & Alternators" at www. samlexamerica. com (Home > Support > White Papers).**
- Use appropriate external fuse (Refer to Table 5.1 on page 27) within 7" of battery Positive terminal.
- External charging source, if any, is connected to the connectors (3) and (4) as shown above. **The maximum capacity of the external charging source is 50A.**

Preventing DC Input Over Voltage

It is to be ensured that the DC input voltage of this unit does not exceed 16 VDC for the 12V battery version G4-2012 and 32 VDC for the 24V battery versions G4-2524 and G4-3524 to prevent permanent damage to the unit. Please observe the following precautions:

- Ensure that the maximum charging voltage of the external battery charger / alternator / solar charge controller does not exceed 16 VDC for the 12V battery version and 32 VDC for the 24V battery version.
- Do not use unregulated solar panels to charge the battery connected to this unit. Under open circuit conditions and in cold ambient temperatures, the output of the solar panel may reach > 22 VDC for 12V battery system and > 44 VDC for 24V battery system. Always use a charge controller between the solar panel and the battery.
- When using Diversion Charge Control Mode in a charge controller, the solar / wind / hydro source is directly connected to the battery bank. In this case, the controller will divert excess current to an external load. As the battery charges, the diversion duty cycle will increase. When the battery is fully charged, all the source energy will flow into the diversion load if there are no other loads. The charge controller will disconnect the diversion load if the current rating of the controller is exceeded. Disconnection of the diversion load may damage the battery as well as G4 / other DC loads connected to the battery due to high voltages generated during conditions of high winds (for wind generators), high water flow rates (for hydro generators). It is, therefore, to be ensured that the diversion load is sized correctly to prevent the above over voltage conditions.
- Do not connect this unit to a battery system with a voltage higher than the rated battery input voltage of the unit (e.g. do not connect the 12V version of the unit to 24V battery system or the 24V version to the 48V Battery System).

Preventing Reverse Polarity On The Input Side

CAUTION!

Damage caused by reverse polarity is not covered by warranty.

When making battery connections on the input side, make sure that the polarity of battery connections is correct (Connect the Positive of the battery to the Positive terminal of the unit and the Negative of the battery

to the Negative terminal of the unit). If the input is connected in reverse polarity, external DC fuse in the input side will blow and may also cause permanent damage to the inverter.

Connection From Batteries / External Charge Controller To The DC Input Side – Sizing of Cables And Fuses

WARNING!

The input section of the inverter has large value capacitors connected across the input terminals. As soon as the DC input connection loop (Battery (+) terminal ⟶ Fuse ⟶ Positive input terminal of G4 ⟶ Negative input terminal of the G4 ⟶ Battery (–) terminal) is completed, these capacitors will start charging and the unit will momentarily draw very heavy current that will produce sparking on the last contact in the input loop even when the ON / OFF switch on the inverter is in the OFF position.

Ensure that the fuse is inserted only after all the connections in the loop have been completed so that sparking is limited to the fuse area.

Flow of electric current in a conductor is opposed by the resistance of the conductor. The resistance of the conductor is directly proportional to the length of the conductor and inversely proportional to its cross-section (thickness). The resistance in the conductor produces undesirable effects of voltage drop and heating. The size (thickness / cross-section) of the conductors is designated by AWG (American Wire Gauge). Conductors thicker than AWG #4/0 are sized in MCM/kcmil.

Conductors are protected with insulating material rated for specific temperature e.g. 90˚C/194˚F. As current flow produces heat that affects insulation, there is a maximum permissible value of current (called "Ampacity") for each size of conductor and temperature rating of its insulation. The insulating material of the cables will also be affected by the elevated operating temperature of the terminals to which these are connected. Ampacity of cables is based on UL-1741 and the National Electrical Code (NEC)-2011. Please see details given under "Notes for Table 5.1", page 26.

The DC input circuit is required to handle very large DC currents and hence, the size of the cables and connectors should be selected to ensure minimum voltage drop between the battery and the inverter. Thinner cables and loose connections will result in poor inverter performance and will produce abnormal heating leading to risk of insulation melt down and fire. Normally, the thickness of the cable should be such that the voltage drop due to the current & the resistance of the length of the cable should be less than 2%. Use oil resistant, multi-stranded copper wire cables rated at 90º C minimum. Do not use aluminum cable as it has higher resistance per unit length. Cables can be bought at a marine / welding supply store.

Effects of low voltage on common electrical loads are given below:

- **Lighting circuits - incandescent and Quartz Halogen:** A 5% voltage drop causes an approximate 10% loss in light output. This is because the bulb not only receives less power, but the cooler filament drops from white-hot towards red-hot, emitting much less visible light.
- **Lighting circuits - fluorescent:** Voltage drop causes a nearly proportional drop in light output.
- **AC induction motors -** These are commonly found in power tools, appliances, well pumps etc. They exhibit very high surge demands when starting. Significant voltage drop in these circuits may cause failure to start and possible motor damage.
- **PV battery charging circuits** - These are critical because voltage drop can cause a disproportionate loss of charge current to charge a battery. A voltage drop greater than 5% can reduce charge current to the battery by a much greater percentage.

ATTENTION!

Des dégats causés par un renversement des polarités n'est pas couverts par la garantie.

Quand vous faites des connexions à la batterie du côté d'entrée, veuillez assurer que les polarités sont mise du bon côté (Lié le positif de la batterie à la borne positive de l'appareil et le négatif de la batterie à la borne négative de l'appareil. Si les polarité de l'entrée sont mise à l'envers, le fusible CC externe du côté d'entrée va s'exploser et peut causer des dégâts permanent à l'onduleur.

ATTENTION!

La section d'entrée de l'onduleur a des condensateurs de grande valeur qui sont connecté aux bornes d'entrées. Tant que le boucle de connexion d'entrée CC (la borne (+) de la batterie ⟶ le fusible ⟶ la borne d'entrée positive du G4 » la borne d'entrée négative du G4 ⟶ la borne (-) de la batterie est complèt, les condesateurs commençeront à recharger. L'appareil prendra un courant fort brièvement pour s'alimenter qui va produire une étincelle sur le dernier contact du boucle d'entrée même si l'interrupteur ON/OFF du l'onduleur est dans la position OFF.

Assurez que le fusible est insèrer seulement après que toutes les connexions sont faites dans le boucle pour que des étincelles se produisent seulement à l'endroit du fusible

Le flux du courant dans un conducteur est opposé par la résistance du conducteur. La résistance du conducteur est corrélative à la longueur du conducteur et inversement corrélatif à son diamètre (l'épaisseur). La résistance dans un conducteur produit des effects indésirables comme une perte de tension et une surchaffe. La taille (l'épaisseur) des conducteurs est classée par le AWG (American Wire Guage). Les conducteurs qui sont plus épais que la taille AWG #4/0 sont classé par MCM/kcmil.

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Les conducteurs sont protègés par des matériaux isolants classés pour une température spécifique, par exemple,une température de 90˚C/194˚F. Le flux de courant produit de la chaleur et affecte l'isolation. Alors, il y a une valeur de courant maximale (aussi appellé « L'ampacité ») qui est permise pour chaque taille de conducteur et pour la classification température de l'isolation. Les matériaux isolants des câbles seront aussi affecter par la température de fonctionnement élèvée des bornes, à qui ils sont connectés. L'ampacité des câbles est basé sur UL-1741 et la Norme Nationale Électrique (NEC)-2011. Veuillez voir les détails qui sont écris à la page 26 « Notes for table 5.1 »

Le circuit d'entrée CC doit subir à des courants CC forts et ainsi, il faut que la taille des câbles et des connecteurs est sélectionnée pour réduire la perte de tension entre la batterie et l'onduleur. Avec des câbles moins épais et des connexions lâches la performance de l'onduleur est diminuée et en plus, ça pourrait produire une réchauffement anormale qui risque de fondre l'isolation ou commencer un incendie. Normalement, il faut que le câble soit assez épais pour réduire la perte de tension, dû au courant/ la résistance du câble, à moins que 2%. Utilisez des câble multifiliares (fils en cuivre et résistant à l'huile) qui sont classés au moins à 90° C. N'utilisez pas des câbles en aluminium car ils ont une résistance plus haute (par la longueur de l'unité). On peut achèter des câbles aux magasins de fournitures pour marin/soudage.

Les effets d'une faible tension pour des charges électriques communes

- ***Circuits d'allumage** - incandescent et Halogène Quartz: Une perte de tension à 5% causera une perte de 10% de la lumière émise. Cet effet est grâce à deux choses, non seulement l'ampoule reçoive moins de puissance mais, aussi le filament refroidi change de la chaleur-blanc à la chaleur-rouge, qui émet moins de lumière visible.*
- ***Circuits d'allumage*** - fluorescent: la perte de tension est presque proportionelle à la perte de la lumière émise.
- ***Moteurs à Induction CA*** - Souvent, Ils font partie des outils électriques, des dispositifs, pompe à puits, etc. Au démarrage, ils exigent une surcharge de puissance. Si la tension baisse trop, ils pourraient pas marcher et même seront endommager.
- ***Circuit de rechargement de batterie PV*** - La perte de tension pourrais causer une perte de puissance disproportionée. Par exemple, une perte de tension à 5% peut réduire le courant de charge par une pourcentage beaucoup plus grande que 5%.

Fuse Protection In The Battery Circuit

A battery is an unlimited source of current. Under short circuit conditions, a battery can supply thousands of Amperes of current. If there is a short circuit along the length of the cables that connects the battery to the inverter, thousands of amperes of current can flow from the battery to the point of shorting and that section of the cable will become red-hot, the insulation will melt and the cable will ultimately break. This interruption of very high current will generate a hazardous, high temperature, high-energy arc with accompanying high-pressure wave that may cause fire, damage nearby objects and cause injury. To prevent occurrence of hazardous conditions under short circuit conditions, the fuse used in the battery circuit should limit the current, blow in a very short time **(should be Fast Blow Type)** and at the same time, quench the arc in a safe manner. For this purpose, **UL Class T fuse or equivalent** should be used (**As per UL Standard 248-15**). This special purpose current limiting, very fast acting fuse will blow in less than 8 ms under short circuit conditions.

Appropriate capacity of the above Class T fuse or equivalent should be installed within 7" of the battery Plus (+) Terminal (Please see Table 5.1, page 27 for fuse sizing).

Marine Rated Battery Fuses, MRBF-xxx Series made by Cooper Bussmann may also be used. These fuses comply with ISO 8820-6 for road vehicles.

DC Input Connection for Battery

Battery is connected to terminals 1, 2 shown in Fig 5.8 (page 24). The terminal consists of M8 Stud & Nut. Tightening torque for the nut is 70 kgf.cm (5 lbf.ft). **Sizes of cables and fuses are shown in Table 5.1.** Sizing is based on safety considerations specified in UL-1741 and NEC-2011. See details under "Notes for Table 5.1".

DC Input Connection for External Charger

External charger is connected to terminals consisting of M8 Stud with Thumb Nut (3, 4 in Fig. 5.8 at page 24).

- Max current fed through these terminals should be < 50A
- Use wire size AWG#4 for distance of up to 10 ft.
- Tightening torque for the Thumb Nut is 35 kgf.cm (2.5 lbf.ft)
- Use 70A Class-T fuse in series with the Positive wire to protect against short circuit along the length of the connecting wires.
  Fuse should be close to the Positive Input Terminal 3.

NOTES FOR TABLE 5.1

1. As per Inverter Mode Specifications under Section 10 - Specifications.
2. Minimum allowable current carrying capacity (ampacity) of the conductor should be 125% of the continuous steady state current - Refer to UL1741 (16.1.3) and NEC-2011 [210.19(A)(1)].
3. Conductor size (in MCM / kcmil or AWG) should be selected based on the minimum allowable ampacity as per Note 2 above and UL1741 (16.1.3) / NEC-2011 [Table 310.15(B)(16)].
4. Wire sizing is based on conductor temperature rating of 90°C / 194°F to match terminal temperature of up to 80°C / 176°F of G4 when operating at higher ambient temp of 50°C / 122°F.
5. Conductor size is based on the minimum size as per UL1741 / NEC-2011 requirements as detailed above or 2% voltage drop along lengths of wires between the battery and the inverter, whichever is thicker (For purposes of voltage drop, the resistance of the conductor is calculated to be twice the distance between the battery and the inverter to cover both the Positive and Negative lengths of wires).
6. Fuse requirements for short circuit protection of battery wiring:
   - 6.1 Fast-acting, Current Limiting, UL Class T (UL Standard 248-15) or equivalent.
   - 6.2.1 Maximum allowable current rating of the fuse is to be limited to 125% of maximum continuous steady state current as per UL1741 [16.1.3] and NEC-2011 [210.20(A)].

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TABLE 5.1: SIZING OF BATTERY SIDE CABLES AND FUSES						
Model No.	Max Continuous Steady State DC Input Current (See Note 1)	125% of Max Continuous Steady State Current (See Note 2)	Conductor Size Based on Ampacity (See Notes 3, 4 & 6)			Maximum External Fuse Size
			3' Distance Size (Ampacity)	6' Distance Size (Ampacity)	10' Distance Size (Ampacity)	
G4-2012A	250A @ 10V	312.5A	MCM/kcmil 300 (320A)	MCM/kcmil 300 (320A)	MCM/kcmil 300 (320A)	320A
G4-2524A	150A @ 20V	187.5A	AWG #2/0 (195A)	AWG #2/0 (195A)	AWG #2/0 (195A)	195A
G4-3524A	215A @ 20V	268.75A	MCM/kcmil 250 (290A)	MCM/kcmil 250 (290A)	MCM/kcmil 250 (290A)	290A

Using Proper DC Cable Termination

The battery end and the inverter end of the wires should have proper terminal lugs that will ensure a firm and tight connection. Choose lugs to fit the wire size and the stud sizes on the inverter and battery ends.

The following terminal lugs have been provided for the inverter end:

- 2 copper terminal lugs for battery wires
  - To accommodate up to MCM/kcmil 250/300 for G4-2012A and G4-3524A and stud size M8
  - To accommodate up to AWG#3/0 for G4-2524A & stud size M8
- 2 copper terminal lugs for external charger wires to accommodate up to AWG#4 & stud size M8

Reducing RF Interference

To reduce the effect of radiated interference, shield the wires with sheathing / copper foil / braiding.

Taping Battery Wires Together To Reduce Inductance

Do not keep the battery wires far apart. Keep them taped together to reduce their inductance. Reduced inductance of the battery wires helps to reduce induced voltages. This reduces ripple in the battery wires and improves performance and efficiency.

AC Side Connections

WARNING!

- **In default condition, the Neutral of the AC output of the unit in the "Inverter Mode" gets bonded to the metal chassis of the unit through the internal "Neutral to Chassis Switching Relay".**

  In the "Utility / Generator Mode", the internal "Neutral to Chassis Switching Relay" disconnects the Neutral of the AC output connection from the chassis of the unit. The Neutral of the AC output connection of the unit will get bonded to the Earth Ground through the Neutral to Earth Ground bond in the Service Entrance / AC output connections of the generator.

- **System grounding, as required by National / Local Electrical Codes / Standards, is the responsibility of the user / system installer.**

Size of terminal slot for wire entry: 6 x 4.5 mm
Wire size accepted by the terminal hole: AWG#6 - 20

9 HOT IN - AC Input , Hot / Line
10 NEU IN - AC Input Neutral
11 GND IN - AC Input Ground
12 GND OUT - AC output Ground
13 NEU OUT - AC out, Neutral
14 HOT OUT - AC out, Hot / Line
15 AC Breaker marked "Charger"
16 AC breaker marked "Load"

Fig 5.9 AC side Layout & Connections

SECTION 5 | Installation

ATTENTION!

Dans la condition normale, le neutre de la sortie CA de l'appareil dans la mode « Onduleur» est lié au châssis métal de l'appareil par le relais de changement du neutre au châssis interne «Neutral to Chassis Switching Relay».

Dans la mode «Utilitaire/Générateur», le «relais de changement du neutre au châssis» interne va déconnecter le neutre de la connexion de sortie CA et le châssis de l'appareil. Le neutre de la connexion de sortie CA de l'appareil serait lié à la mise à la terre, à travers le liason du neutre et la mise à la terre, qui existe à l'entrée de service/connexions de sortie CA du générateur.

C'est la responsabilité de l'utilisateur ou ceux qui installe le système, de mettre le système à la terre, qui est réquis par les Normes Nationales/Locales Électriques.

AC Transfer and Ground-To-Neutral Bond Switching In G4 Series

As required by NEC and UL specification 458, inverter / charger installations in the U.S. that are used in RV or Marine applications should be provided with a "Neutral to Ground Bond Switching Relay" to switch bonding of the Neutral Output Connector of the Inverter Charger as follows:

- When operating as an inverter, the current carrying conductor of the Inverter Section that is connected to the Neutral Out connector of the Inverter Charger should be bonded to the metal chassis of the inverter by the "Neutral to Ground Bond Switching Relay". As the metal chassis of the inverter is in turn bonded to the RV Ground (chassis of the RV) or to the Boat Ground (DC Negative Grounding Bus Bar and the Main AC Grounding Bus Bar are tied together in a boat and this is called the "Boat Ground"), this current carrying conductor of the Inverter Section will become the Grounded Conductor (GC) or the Neutral of the Inverter Section. This meets NEC requirements
- When in the Utility / Generator Modes, the Neutral of the shore power will be connected to the Neutral Out connector of the Inverter Charger. At the same time, the "Neutral to Ground Bond Switching Relay" will unbond (disconnect) the Neutral Out connector of the Inverter Charger from the chassis of the Inverter Charger. This will ensure that the Grounded Conductor (GC) / Neutral of the shore power is bonded to the Earth Ground at one single point at the location of the AC Power Distribution System of the Marina/RV Park.
- In some marine applications, Neutral-to-Ground switching is not required or acceptable. The potential for galvanic corrosion caused by small leakage currents between boats with dissimilar metals is present. The proper and safe ways to prevent this is by using galvanic isolators or include an isolation transformer for the AC input. Disconnecting the common ground between the AC and DC system could contribute to a hazardous and potentially fatal situation.

  Please read the following on-line White Papers for more details at www.samlexamerica.com (Home > Support > White Papers):

  - "Grounded Electrical AC Power Distribution"
  - "Grounding System and Lightning / Ground Fault Protection"
  - "Neutral to Ground Switching in RV and Marine Applications"

Schematic at Fig. 5.10, page 29 explains implementation in the G4 series.

The Bi-directional Transformer is used as follows:

- Feeds AC output from the Inverter Section when shore power is not available.
- Feeds utility / shore power to the Battery Charger Section when shore power / utility is available.

Switching of Hot Output (HOT OUT)

- Relays K1 and K4 are rated at 40A each and operate in parallel (effective capacity of 80A). These are used to switch the Hot Output Connector (HOT OUT) to either the Inverter Section or to the Utility / Shore Power
- When Utility / Shore Power is available, relays K1 and K4 are energized and contact 4 switches over to contact 5. The Bi-directional Transformer works as a battery Charger. The Hot AC input (HOT IN) from the shore power is fed to the Hot input of the Bi-directional Transformer for battery charging and at the same time, it is fed to the Hot Out (HOT OUT) for powering the load
- When Utility / Shore Power fails, relays K1 and K4 are de-energized and contact 4 switches over to contact 3. The Bi-directional Transformer operates as an inverter. Hot AC output from the Bi-directional Transformer is fed to the Hot Out (HOT OUT) for powering the load

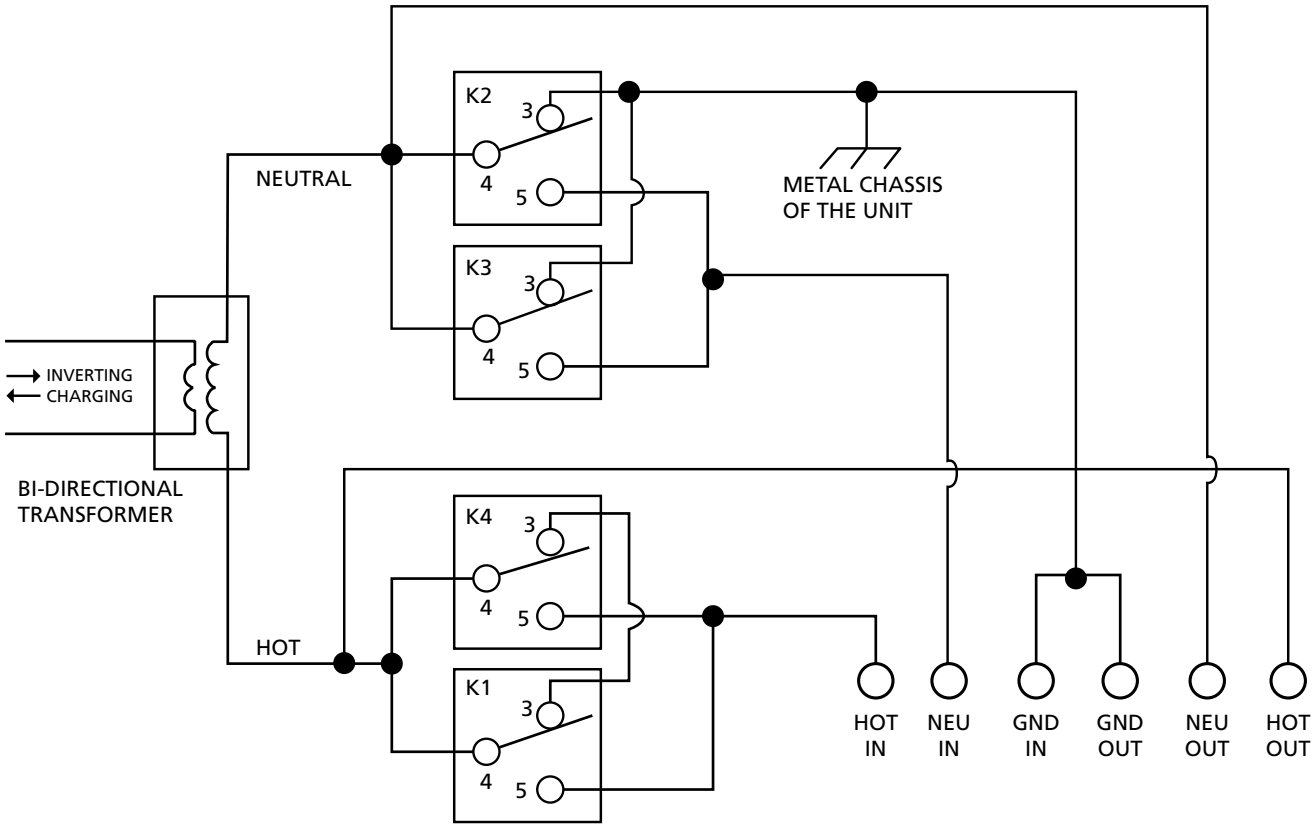
Switching of Neutral to Ground Bonding

- Relays K2 and K3 are also rated at 40A each and operate in parallel (effective capacity of 80A). These are used to switch the bonding of the Neutral Out Connector (NEU OUT) to the chassis of the G4
- When Utility / Shore Power is available, K2 and K3 are energized and contact 4 switches over to contact 5. The Bi-directional Transformer works as a battery Charger. AC input Neutral (NEU IN) from the shore power is fed to the Neutral input of the Bi-directional Transformer for battery charging and at the same time it is connected to the Neutral Out (NEU OUT) for powering the load. The Neutral Out (NEU OUT) is isolated from the chassis of the G4
- When Utility / Shore Power is removed, K2 and K3 are de-energized and contact 4 switches over to contact 3. The Bi-directional Transformer operates as an inverter. One of the current carrying conductors of the Bi-directional Transformer that is connected to contact 4 is now bonded to the chassis of G4 through contact 3.

  This conductor now becomes a Grounded Conductor (GC) or Neutral. At the same time, the Neutral out of the Bi-directional Transformer is connected to the Neutral Out (NEU OUT). The Neutral out (NEU OUT) is bonded to the chassis of G4.

AC Input Considerations – Voltage And Frequency

The G4 unit is designed to accept 120 VAC, 60 Hz / 50 Hz single phase AC power from utility or generator. The 120V versions come preset for



K1, K4	Relays (in parallel) for Hot Switching
K2, K3	Relays (in parallel) for Neutral to Ground Bond Switching
3, 4	Normally closed contacts
4-5	Normally open contacts

NOTE:
Relays K1 to K4 are de-energized in Inverter Mode and are energized in Utility / Generator Mode

Fig. 5.10 Operation of Transfer Relay and Neutral to Ground Bond switching in G4 series

60 Hz operation. The unit has the capability to auto-sense 50 / 60 Hz. For example, assume that it is a 120 VAC unit that is preset at 60 Hz. If the unit is fed with 120 VAC at 50 Hz instead of 60 Hz, the unit will automatically reset at 50 Hz on switching on and will remain set at 50 Hz. as long as the 120V, 50 Hz is available and the unit continues to be in the on position. Once the unit is switched off, it will automatically restart in the preset frequency of 60 Hz. If now it sees 50 Hz once again, it will set itself automatically to 50 Hz again.

WARNING!

Preventing Paralleling of the AC Output

The AC output of the unit cannot be synchronized with another AC source and hence, it is not suitable for paralleling on the output side. The AC output of the unit should never be connected directly to an electrical breaker panel / load center which is also fed from the utility power / generator. Such a connection may result in parallel operation of the different power sources and AC power from the utility / generator will be fed back into the unit which will instantly damage the output section of the unit and may also pose a fire and safety hazard. If an electrical breaker panel / load center is fed from this unit and this panel is also required to be powered from additional alternate AC sources, the AC power from all the AC sources like the utility / generator / inverter should first be fed to a selector switch and the output of the selector switch should be connected to the electrical breaker panel / load center. To prevent possibility of paralleling and severe damage to the inverter, never use a simple jumper cable with a male plug on both ends to connect the AC output of the inverter to a handy wall receptacle in the home / RV.

Connecting to Multi-wire Branch Circuits

DO NOT directly connect the Hot side of the 120 VAC of the unit to the two Hot Legs of the 120 / 240 VAC Breaker Panel / Load Center where Multi-wire (common Neutral) Branch Circuit wiring method is used for distribution of AC power. This may lead to overloading / overheating of the Neutral conductor and is a risk of fire.

A split phase transformer (Isolated or Auto-transformer) of suitable VA rating (25 % more than the VA rating of the unit) with Primary of 120 VAC and Secondary of 120 / 240 VAC (Two 120 VAC split phases 180 degrees apart) should be used. The Hot and Neutral of the 120 VAC output of the inverter should be fed to the Primary of this transformer and the 2 Hot outputs (120 VAC split phases) and the Neutral from the Secondary of this transformer should be connected to the Electrical Breaker Panel / Load Center.

Please see details on-line under White Paper titled "120 / 240 VAC Single Split Phase System and Multi-wire Branch Circuits" at: www.samlexamerica.com (Home > Support > White Papers).

ATTENTION!

Pour Empêcher La Sortie CA De Se Mettre En Parallèle

La sortie CA de l'appareil ne peut pas être synchronisé avec une autre source CA et ainsi, ce n'est pas approprié de la mettre en parallèle sur le côté de la sortie. La sortie CA de l'appareil devrait jamais être directement branché à un panneau de disjonction électrique/ centre de charge qui est aussi alimenté par la puissance utilitaire/ de générateur. Une connexion pareille pourrais résulter dans une fonctionnement en parallèle de ces sources divers de puissance et, la puissance CA produite par l'utilitaire/générateur serait alimentée à l'appareil causant des dégâts à la section de sortie, engendrant une risque d'incendie ou de faire mal. Si le panneau de disjonction électrique/centre de charge est alimenté par l'appareil et une puissance provenant des autres sources CA est requise, la puissance CA venant de toutes les sources comme l'utilitaire/générateur/ onduleur devrait être alimentée en premier, à un sélecteur et, la sortie du sélecteur devrait être liée au panneau de disjonction/centre de charge. Pour empêcher la possibilité que l'onduleur se met en parallèle ou s'endommage sévèrement, n'utilisez pas un câble de raccordement avec un fiche de chaque côté pour brancher la sortie CA de l'onduleur à un réceptacle de mur commode dans la maison/VR.

Connexion aux Circuits Multi-Fils

CONNECTEZ PAS le côté chaud de l'appareil de 120 VCC directement aux deux jambes chaudes du panneau de disjonction/centre de charge de 120/240 VCC, où la méthode de connexion des circuits multi-fils (Neutre commun) est utilisée pour la distribution de puissance CA. Ça pourrait engendrer une surcharge/surchauffe du conducteur neutre et la risque d'un incendie.

Un transformateur de phase auxiliare (isolé ou auto-transformateur) d'une classification de watts acceptable (25% plus que la classification de watts de l'appareil) avec une phase primaire de 120 VCA et phase sécondaire de 120/240 VCA (deux phase auxiliaires de 120 VCA écarté par 180 dégrées) devrait être utilisé. La sortie de 120 VCA (Chaude et neutre) de l'onduleur devrait alimenté à la phase primaire du transformateur et les deux sorties chaudes (phase auxiliaires de 120 VCA) et le neutre de la phase sécondaire devrait être connecté au panneau de disjonction/centre de charge.

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AC Input & Output Connection

WARNING!

Please ensure that the AC input voltage from the utility / generator is connected to the AC input terminals and not to the AC output terminals and that this connection is made only when the unit is in off condition.

Please note that when the unit is powered on, a Self Test is carried out which includes a check if the AC input voltage from the utility / generator connection has been erroneously connected to the AC output terminals instead of AC input terminals. If this wrong connection is detected, the unit will not be powered on and a message "Wiring Error" will be displayed. This protection against error in connection of the AC input wiring is active only when this wrong connection is made when the unit is in off condition and is switched on subsequently.

If the AC input voltage from the utility / generator is erroneously connected / fed to the AC output connections when the unit is on condition, the Inverter Section will be burnt instantaneously and may become a fire hazard.

The AC input and output supply connections are located in a pocket protected by a cover with a removable front plate (17, Fig 2.2, page 8). The cover plate has multiple 27.8mm / 1$^{3}/_{32}$" diameter knockout holes for cable / conduit entry. Remove the required knockouts from the cover plate and install appropriate ¾" Trade Size Box Fitting for routing the AC input and output wires/conduits.

Moving cage clamp type of terminal block is used for connecting the wires. The slot size for wire entry is 6x4.5 mm and set screw size is M4. It can accommodate conductors with solid or multi-stranded wire size range of AWG #6 to AWG #20.

Strip 9 to 11 mm of insulation from the end of the wire (Fig. 5.11). Avoid nicking the wire when stripping the insulation.

Insert the bare end of the wire fully into the terminal slot till it stops. Tighten the screw firmly. Tightening torque for the screws – 7 to 12 Kgf*cm / 0.5 to 0.9 lbf*ft.

ATTENTION!

Veuillez assurer que la tension d'entrée CA de l'utilitaire/générateur est connecté aux bornes d'entrée CA, pas aux bornes de sortie CA et, que la connexion est faite seulement quand l'appareil est fermé.

Veuillez noter que dés que l'appareil est mis en marche, un test est fait automatiquement pour verifier si la tension d'entrée CA de l'utilitaire/ générateur est liée, par erreur, aux bornes de sortie CA au lieu des bornes d'entrée CA. Si la mauvaise connexion est détectée, l'appareil démarrera pas et, un message «wiring error» serait affiché. Cette protection est active seulement quand la mauvaise connexion est faite et si l'appareil est déja fermé et puis mis en marche.

Si la tension d'entrée venant de l'utiliaire/générateur est liée, par erreur, aux bornes de sortie CA pendant que l'appareil est en marche, la section de l'onduleur serait brûlée instantanément et poserait une risque d'incendie

Les connexions d'alimentation d'entrée et sortie CA sont trouvées dans une poche protègé par une couverture avec une plaque amovible (17, Fig. 2,2, à la page 8). La plaque a plusieurs trous q'on peut enlever, d'un diamètre de 27.8mm/13/32" pour le câble/tuyau. Enlevez autant de trous que nécessaire et installez un raccord boîte de la taille 8/4" pour l'insertion des câbles/tuyaus de d'entrée et sortie CA.

Un bornier, type crampon avec cage déplacable, est utilisé pour brancher les câbles. La taille de la rainure est 6x4.5 mm et la taille de la vis est M4. Ça peut accomoder des conducteurs avec des câbles solides ou multi-fil des tailles AWG#6 à AWG #20.

Enlevez 9 à 11 mm de l'isolation du câble (Fig. 5.11). Ne griffez pas le câble quand vouz enlevez l'isolation.

*Inserez complètement le bout dénudé du câble dans la rainure terminale. Serrez la vis fermement. La torque de serrage pour les vis est - 7 à 12 Kgf*cm / 0.5 à 0.9 lbf*ft.*

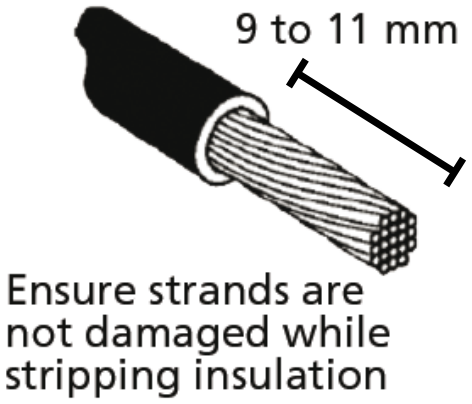


Fig 5.11 Stripped wire end

SECTION 5 | Installation

Please see Fig. 5.9 (page 27) showing the AC side layout and connection arrangement of the unit. The terminals are marked as follows:

- The AC input terminals are marked "HOT IN" (9) for the Line Input and "NEU IN" (10) for the Neutral Input.
- The AC output terminals are marked "HOT OUT" (14) for the Line Output and "NEU OUT" (13) for the Neutral Output.
- The "Equipment Grounding Connections" are marked "GND IN" (11) for the Equipment Grounding Conductor from the utility / generator and "GND OUT" (12) for the Equipment Grounding Conductor to the AC Load Center/AC Sub-Panel.

GFCI Protection for Vehicle Application

When this unit is installed in vehicles, ensure that Ground Fault Circuit Interrupter(s) are installed in the vehicle wiring system to protect all branch circuits. Details of tested and approved GFCI's are given in Fig 5.14 (page 36). Installation requirements are shown in Fig. 5.14 on page 36.

Sizes Of AC Input , AC Output Wiring

The type of the wire should be suitable for the application – residential, RV or marine.

The units are provided with built-in breaker marked "Charger" for over-current protection on the AC input and output sides. The ampacity of AC wiring has to match the current rating of the breaker. Sizing is based on UL1741 (Section 16.1.3 and Table 66.3) and 75°C / 167°F temperature rating column of NEC-2011 Table 310.15(B)(16) for wiring installed in conduit. Wiring with higher conductor temperature rating of 90°C / 194°F may be used but wire sizing has to be based on 75°C / 167°F temperature rating column of the above NEC Table. Table 5.2 below specifies the sizes of built-in breakers and AC side wiring.

TABLE 5.2: AC INPUT & OUTPUT WIRE SIZING

Model No.	Size of Built-in Breaker Marked "Charger"	Size of Wire
G4-2012A	40A	AWG #8
G4-2524A	40A	AWG #8
G4-3524A	60A	AWG #6

Making The AC Connections

- Connect the black wire from the Hot side of the utility / generator AC power to the terminal labeled HOT IN (9).
- Connect the white wire from the Neutral side of the utility AC power source to the terminal labeled NEU IN (10)
- Connect the green wire from the ground of the AC power source to the terminal marked GND IN (11)
- Connect the black wire from the terminal marked HOT OUT (14) to the Hot bus of your AC Load Center or AC Sub-panel.
- Connect the white wire from the terminal marked NEU OUT (13) to the Neutral bus of your AC Load Center or AC Sub-panel.
- Connect the GND OUT of the inverter to the Equipment Grounding Bus of the AC Load Center or AC Sub-panel.
- Tightening torque for the connections - 7 to 12 kgf.cm (0.5 to 0.9 lbf.ft)

Over Current Protection On The External AC Input and Output Circuits

Ensure that the circuit feeding the AC input of G4 and the circuit feeding the AC output from G4 to a Service Panel have the following minimum over-current protection devices:

- G4-2012A - 40A
- G4-2524A - 40A
- G4-3524A - 60A

Grounding To Earth Or To Other Designated Ground

For safety against electrical shock, the metal chassis of unit is required to be grounded to the Earth Ground or to the other designated ground. For example, in a mobile RV, the metal frame of the RV is normally designated as the Negative DC ground / RV Ground. Similarly, Boat Ground is provided in the boats.

An Equipment Grounding Connector (5 in Fig. 5.8) has been provided on the metal chassis of the G4 for connecting to the appropriate ground through the Equipment Grounding Conductor (EGC). This Equipment Grounding Conductor (EGC), when appropriately bonded to Earth Ground, helps to prevent electric shock and allow over-current devices to operate properly when ground faults occur. The size of this conductor should be coordinated with the size of the over-current devices involved. Marine installations require the size of this conductor to be of the same size as the Battery Negative wire.

Please read following on-line White Papers for complete understanding of Grounding at www.samlexamerica.com (Home > Support > White Papers):

- "Grounded Electrical AC Power Distribution system"
- "Grounding System and Lightning / Ground Fault Protection"
- "Neutral to Ground Switching in RV and Marine Applications"

Grounding Arrangement In G4 Series

Schematic at Fig. 5.12 (page 33) illustrates the grounding arrangement of G4 Series.

Internally, G4 consists of a DC Section and an AC Section that are isolated through a transformer. Both these sections are required to be grounded appropriately.

DC Side Grounding (See Fig. 5.12)

DC side grounding involves proper grounding of the Negative of the battery, the DC Panel and the DC side of the G4.

A Grounding Connector 4 (5 in the DC side layout in Fig. 5.8) is provided for connecting to the Equipment Grounding Conductor (EGC) for the DC side grounding. The connector can accept wire sizes AWG # 4–14. The set screw size is 5/16" – 24 UNC.

A DC Panel, as shown in Fig. 5.12, is normally provided to connect the batteries and distribute DC power to the inverter and the other DC loads.

The Negative of the battery is connected to the Neg (-) Bus, which is connected to the Bus bar for Equipment Grounding Conductors (2), which in turn is bonded to the Grounding Electrode (GE). Hence, the

SECTION 5 | Installation

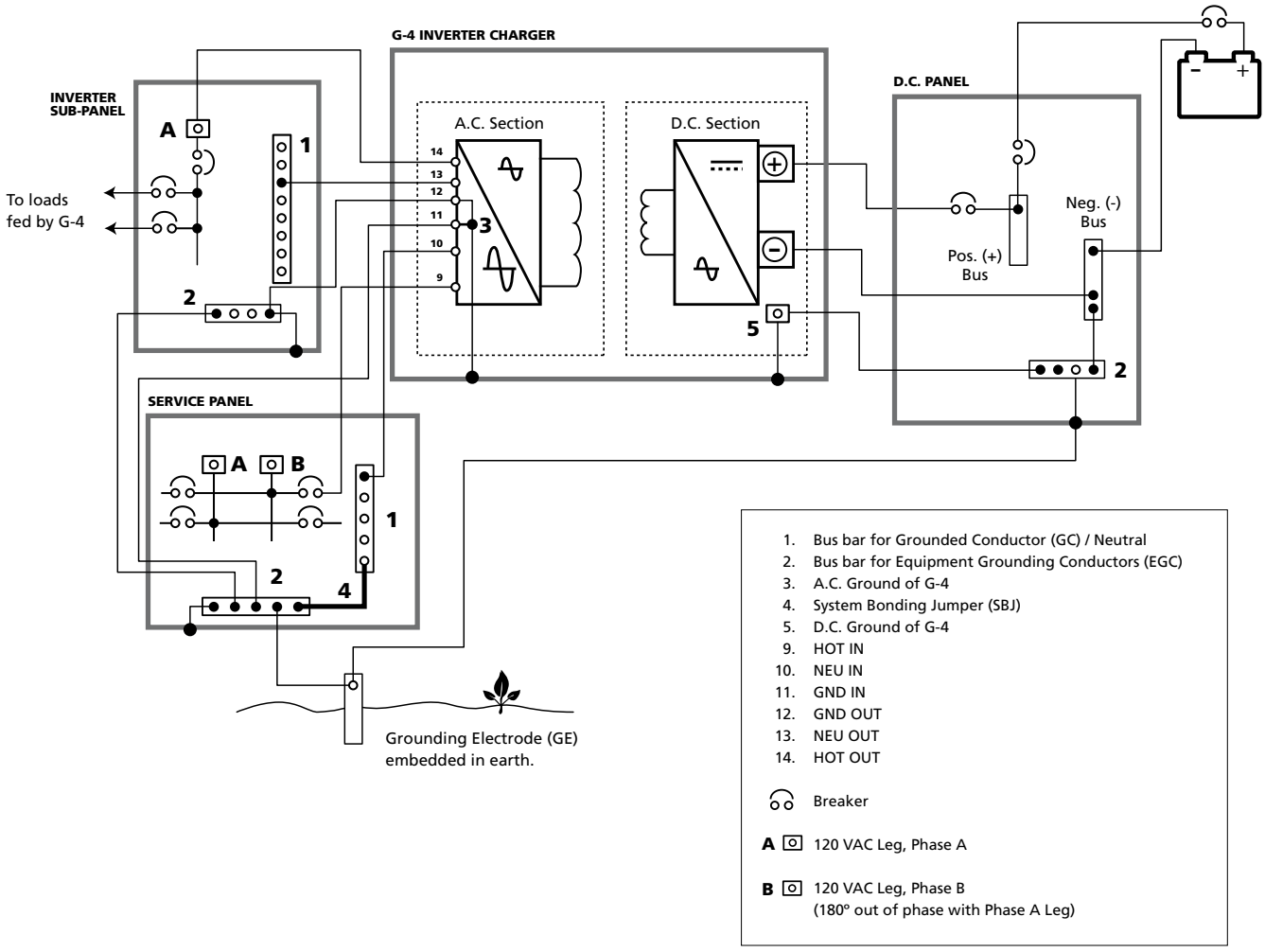


Fig. 5.12: Grounding arrangement – G4 Series

Battery Negative and the chassis of the DC Panel and the chassis of the G4 will all be bonded to the Earth Ground.

Connect the DC Ground of G4 (5) (5 in the DC side layout in Fig. 5.8, page 24) to the Equipment Grounding Bus Bar (2) in the DC Panel using AWG #6 insulated stranded copper wire. For application of G4 on a boat, the size of this wire should be of the same size as the battery Negative wire.

The connections must be tight against bare metal. Use star washers to penetrate paint and corrosion. **As the Equipment Grounding Bus Bar (2) in the DC Panel is bonded to the Grounding Electrode (GE), the chassis of the G4 / DC side will be bonded to Earth Ground.**

WARNING!

For application of G4 on a boat,the size of the Equipment Grounding Conductor (EGC) for the DC side grounding should be of the same size as the battery Negative wire.

ATTENTION!

Si vous utilisez le G4 sur un bateau, la taille du conducteur de terre de l'équipement «EGC» pour le côté de terre CC devrait être de la même taille que le câble négatif de la batterie.

AC Side Grounding (Please see Fig 5.12)

AC side grounding involves the AC side grounds of the G4 (Terminals GND IN and GND OUT), the Inverter Sub-Panel (Bus Bar for Equipment Grounding Conductors) and the Service Entrance (Bus Bar for Equipment Grounding Conductors):

- The AC Input Ground (GND IN, 11) and AC Ouput Ground (GND OUT, 12), are internally bonded to the chassis of the inverter (3)
- The Equipment Grounding Conductor (part of the AC input wiring) from Bus Bar for the equipment Grounding Conductors in the Service

Panel / Load Center (2) is connected to the AC input Ground terminal of the G4 (GND IN, 11).

- The AC output Ground terminal of the G4 (GND OUT, 12) is connected to the Equipment Grounding Conductor of the AC output wire which then connects to the Bus Bar for the Equipment Grounding Conductors of the Inverter Sub Panel (2).
- The Bus Bar for Equipment Grounding Conductors (2) of the inverter Sub Panel is connected to the Bus Bar for the Equipment Grounding Conductors (2) of the Service Panel, which in turn is connected to the Grounding Electrode.
  Thus, in keeping with the NEC requirements, the AC Grounds of G4 and the Inverter Sub-panel will be bonded to the Earth Ground only at one single point at the Service Panel feeding the G4.

Typical Shore Based Installation

Fig. 5.13 (page 35) illustrates a typical shore based installation

- Remote Control has been removed from the top panel of the unit and has been connected to the Remote Control Port
- Battery is connected to the DC input connections through an appropriate fuse to protect the DC input cables against short circuit
- The Battery Temperature Sensor Model BTS-G4 is installed on the Positive post of the battery and connected to the port for the Temperature Sensor
- Supplementary battery charging is being carried out through a solar array and a Charge Controller connected to the DC input provided for external battery charger. **The following Solar products from Samlex America, Inc. are recommended:**
  - Solar Kits
  - Solar Expansion Kits
  - Charge Controllers
- AC input to the G4 is fed from the Service Panel / Load Center
- AC output from the G4 is fed to the Inverter Sub Panel

RV Installation – General Information

GFCI Protection For Vehicle Application. When this unit is installed in vehicles, it is to be ensured that Ground Fault Circuit Interrupter(s) [GFCI] are installed in the vehicle wiring system to protect all branch circuits

The following GFCIs have been tested to operate satisfactorily and are acceptable:

Manufacturer of GFCI	Manufacturer Model No.	Description
Pass & Seymour	2095W	NEMA5-20 Duplex 20A
Pass & Seymour	1595-W	NEMA5-15 Duplex 15A
Leviton	7899-W	NEMA5-20 Duplex 20A
Leviton	T7599-W	NEMA5-15 Duplex 15A
Leviton	7599-W	NEMA5-15 Duplex 15A

Requirement Of Deep Cycle, Auxiliary Battery And Battery Isolator For Powering Inverters In RV / Vehicles. For details, read on-line White Paper titled "Batteries, Chargers & Alternator" at: www.samlexamerica.com (Home > Support > White Papers).

An RV / vehicle has Starter, Lighting and Ignition (SLI) battery. As explained in White Paper titled "Batteries, Chargers and Alternators", SLI batteries are designed to produce high power in short bursts for cranking. SLI batteries use lots of thin plates to maximize the surface area of the plates for providing very large bursts of current (also specified as Cranking Amps). This allows very high starting current but causes the plates to warp when the battery is cycled. Vehicle starting typically discharges 1%–3% of a healthy SLI battery's capacity. The automotive SLI battery is not designed for repeated deep discharge where up to 80% of the battery capacity is discharged and then recharged. If an SLI battery is used for this type of deep discharge application, its useful service life will be drastically reduced. Hence, this type of battery is not recommended for the storage of energy for inverter applications. A second deep cycle auxiliary battery must be installed in the RV for powering the G4 (A deep cycle, auxiliary battery is shown in Fig. 5.14 (page 36).

When the second auxiliary deep cycle battery is used, a Battery Isolator is required that will allow parallel connection of the two batteries for charging when the alternator is on and disconnecting the parallel connection when the alternator is stopped (Isolator is shown in Fig. 5.14). The capacity of the Battery Isolator should be as follows:

- **For G4-2012A:** The maximum continuous DC current required by G4-2012A is 250A. The capacity of the Battery Isolator should be more than 250A or more than the capacity of the alternator, whichever is higher
- **For G4-2524A:** The maximum continuous DC current required by G4-2524A is 150A. The capacity of the Battery Isolator should be more than 150A or more than the capacity of the alternator, whichever is higher
- **For G4-3524A:** The maximum continuous DC current required by G4-3524A is 215A. The capacity of the Battery Isolator should be more than 215A or more than the capacity of the alternator, whichever is higher

Requirement Of External Transfer Relay When Using Generator Or Shore Power To Feed AC Input To G4

Some RVs have on-board / outboard generator to power larger AC loads like air-conditioner. The generator feeds the Main AC Panel of the RV through a manual Transfer Switch or through an Automatic Transfer Relay. This is to ensure that only one AC source (either the shore power or the generator) feeds the Main AC Panel at one time and that the two AC sources (shore power / generator) do not operate in parallel at any time. When generator power is not available, the shore power is connected to the Main AC Panel. When the Generator is started, the Transfer Relay senses the incoming generator power and after a specified delay (equal to warm up time of generator of 20 to 30 sec), disconnects the shore power first from the Main AC Panel and then connects the generator power to the Main AC Panel. A Transfer Relay is shown in Fig. 5.14.

Requirement To Keep The Neutral Conductor Of Shore Power Isolated From The Chassis Ground Of The RV

As explained in on-line White Paper titled "Grounded Electrical Power Distribution System" at www.samlexamerica.com (Home > Support > White Papers), in the RV, the Neutral Bus Bar is NOT bonded to the Chassis of the RV. In the RV, the Neutral is floating with respect to the chassis of the RV. This is necessary for safety because if the Neutral was bonded to the chassis of the RV and if the Neutral and the Hot got reversed by mistake, the chassis of the RV will be at 120 VAC with respect to the Earth Ground. If a person standing on the Earth Ground touches the chassis of the RV, he will be fed with 120 VAC and he will be electrocuted!

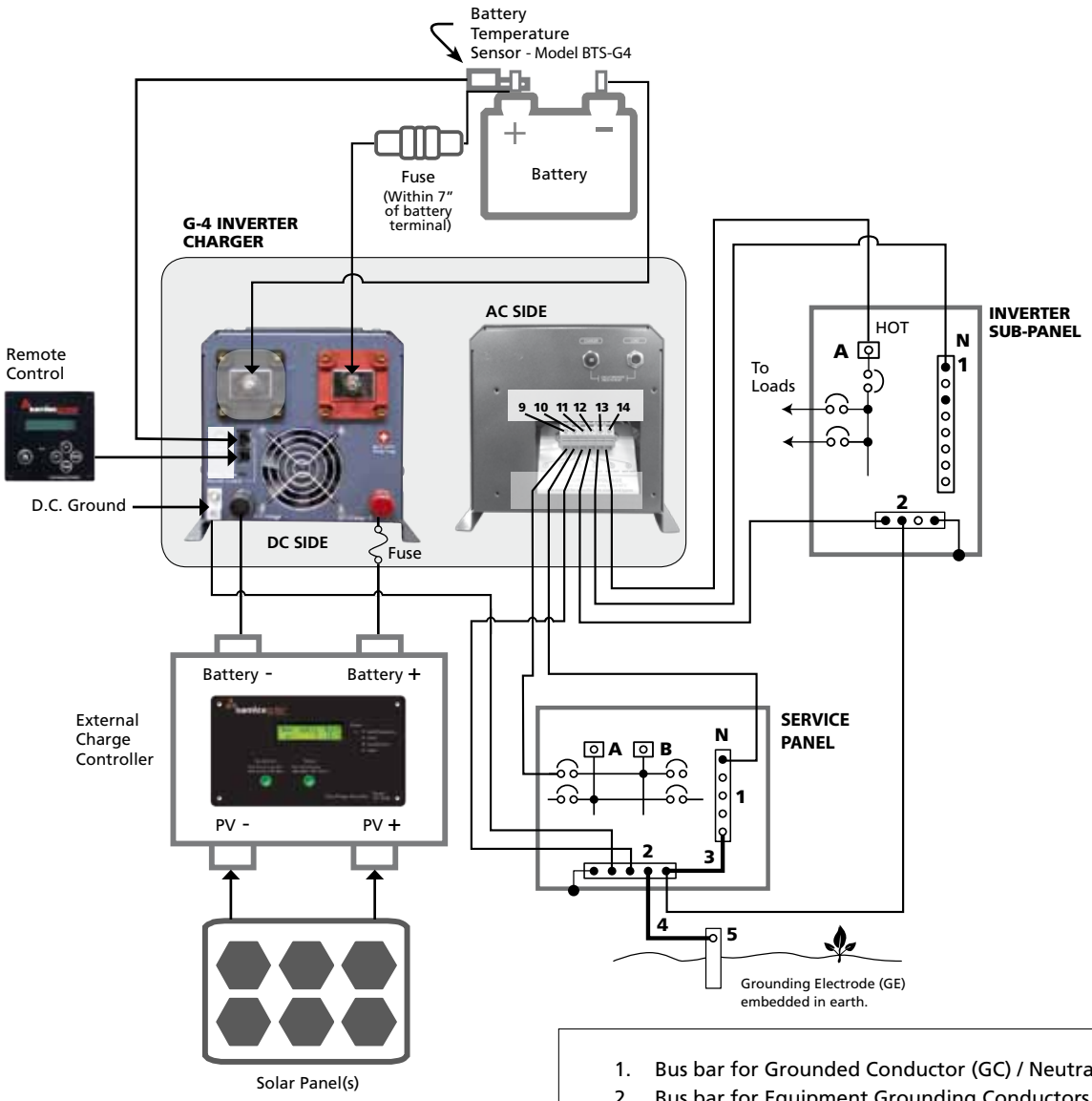


Fig. 5.13: Typical shore based installation of G4

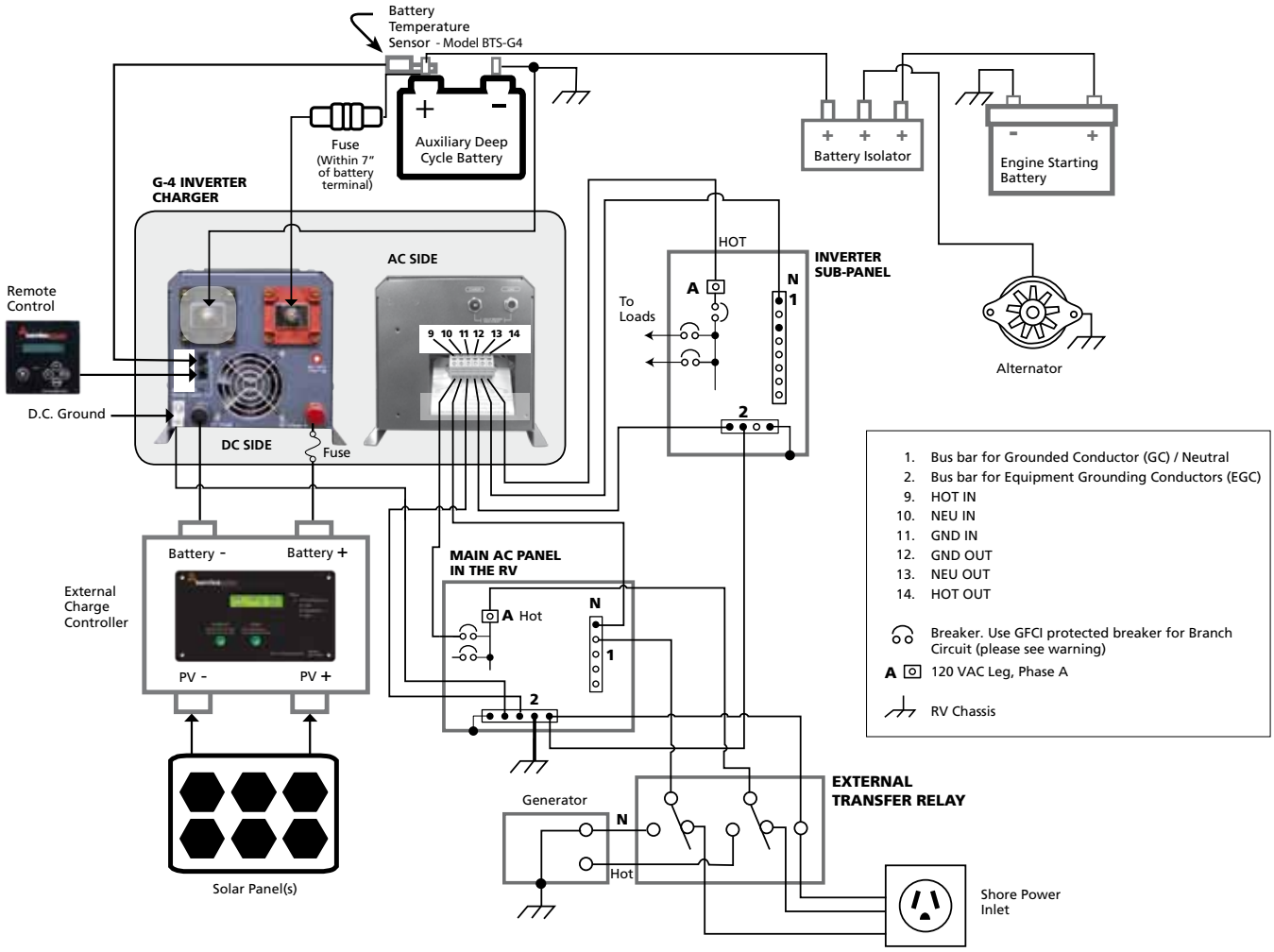
1. Bus bar for Grounded Conductor (GC) / Neutral
2. Bus bar for Equipment Grounding Conductors (EGC)
3. System Bonding Jumper (SBJ)
4. Grounding Electrode Conductor (GEC)
5. Grounding Electrode (GE)
9. HOT IN
10. NEU IN
11. GND IN
12. GND OUT
13. NEU OUT
14. HOT OUT

Breaker

A 120 VAC Leg, Phase A

B 120 VAC Leg, Phase B
(180° out of phase with Phase A Leg)

SECTION 5 | Installation



WARNING!

Please ensure that Ground Fault Circuit Interrupter(s) [GFCI] are installed in the vehicle wiring system to protect all branch circuits.

The following GFCIs have been tested to operate satisfactorily and are acceptable:

Mfr. of GFCI	Manufacturer's Model No.	Description
Pass & Seymour	2095W	NEMA5-20 Duplex 20A
Pass & Seymour	1595-W	NEMA5-15 Duplex 15A
Leviton	7899-W	NEMA5-20 Duplex 20A
Leviton	T7599-W	NEMA5-15 Duplex 15A
Leviton	7599-W	NEMA5-15 Duplex 15A

ATTENTION!

Veuillez assurer que le(s) disjoncteur(s) de terre [GFCI] est/sont installé dans le système de câblage du véhicule pour protèger tous les circuits de dérivation.

Des disjoncteurs de terre ci-dessous ont été testé. Leur fonctionnement est acceptable:

Fabricant	Num. de Modèle du Fabricant	Description
Pass & Seymour	2095W	NEMA5-20 Duplex 20A
Pass & Seymour	1595-W	NEMA5-15 Duplex 15A
Leviton	7899-W	NEMA5-20 Duplex 20A
Leviton	T7599-W	NEMA5-15 Duplex 15A
Leviton	7599-W	NEMA5-15 Duplex 15A

Fig.5.14: Typical RV Installation

SECTION 5 | Installation

Typical RV Installation

Fig. 5.14 illustrates a typical RV installation:

- Remote Control has been removed from the top panel of the unit and has been connected to the Remote Control Port
- Auxiliary Battery is connected to the DC input connections through an appropriate fuse to protect the DC input cables against short circuit
- Auxiliary battery will be charged by the alternator through the Battery Isolator
- Battery Temperature Sensor Model BTS-G4 is installed on the Positive post of the auxiliary battery and connected to the port for the Temperature Sensor
- Supplementary battery charging is being carried out through a solar array and a Charge Controller connected to the DC input provided for external battery charger. **The following Solar products from Samlex America, Inc are recommended:**
  - Solar Kits
  - Solar Expansion Kits
  - Charge Controllers
- AC input to the G4 is fed from the Main AC Panel of the RV. AC power from either shore power or from generator is fed to the Main AC Panel through the external Transfer Relay
- AC output from the G4 is fed to the Inverter Sub Panel

SECTION 6 | LCD Control Panel for Local and Remote Use

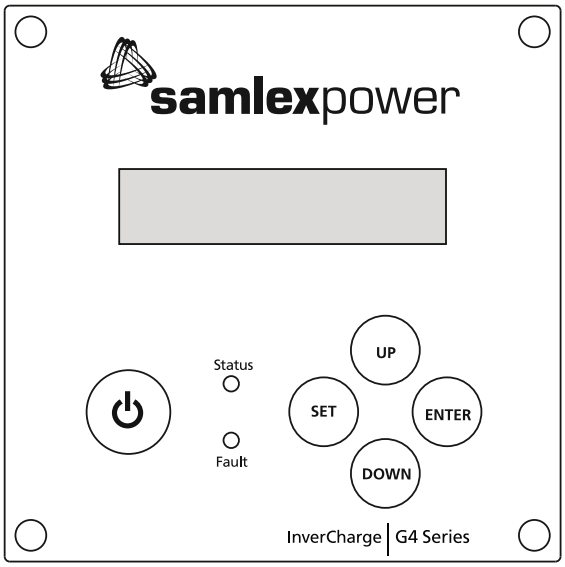


Fig. 6.1: LCD Control Panel

General

The unit comes with a removable LCD Control Panel as shown in Fig. 6.1 that is mounted in a pocket on the top cover of the unit with the help of 4 screws. The dimensions of the panel are (L) 110 X (W) 110 X (Depth) 30 mm.

The LCD Control Panel is used to configure and monitor the operation of the unit.

This LCD Control Panel can be removed and installed at a distance of up to 10 Meters from the main unit with the help of 10 Meters of connecting cable that has been provided with the unit. The cable comes with 8P8C (8 Position, 8 Conductor) Modular Plugs at either ends. An 8P8C Modular Jack marked "Remote Control" is provided on one of the sides of the main unit for connecting the cable. The LCD Control Panel uses RS-485 Digital Serial Communications Interface for communicating with the unit.

Installing LCD Remote Control On Wall / Panel

The LCD Control Panel may be installed flush on a wall / panel. For this, a 91 mm X 91 mm X 50 mm pocket will be required to be created in the wall / panel for accommodating the protrusion and cable bending radius at the back of the panel. Use 4 screws to fix to the wall / panel.

SECTION 6 | LCD Control Panel for Local and Remote Use

Remove and install the LCD Control Panel for remote installation as follows:

- Remove the 4 screws securing the LCD Control Panel to the top cover of the unit
- Pull the panel up slowly and disconnect the 8P8C Modular Jack. Cover the exposed pocket in the top cover with the blank cover plate that has been provided and fix this cover plate with the 4 screws.
- Connect 8P8C Modular Plug on one end of the connecting cable to the 8P8C Modular Jack marked "Remote Control" (7, Fig 2.1, page 8). Route the cable to the location where the LCD Control Panel is to be installed. Connect the 8P8C Modular Plug on the other end of the cable to the 8P8C Modular Jack on the LCD Control Panel and fix it to the wall / panel

Layout Of The LCD Control Panel

The LCD Control Panel consists of the following:

LCD Display: consisting of 2 lines each that can display up to 16 Alpha Numeric characters each. Each character is 5x7 matrix. It is used to display the operational information and the set up prompts.

ON /OFF Key: Used to turn ON and turn OFF the unit. For turning the unit ON, press and hold the Key for approximately 3 seconds till a beep is heard and release the Key after hearing the beep. Similarly, for switching OFF the unit, press and hold the Key for approximately 3 seconds till a beep is heard and release the Key after hearing the beep.

- **"Up" and "Down "Keys:** Are used to scroll the Display Screen forward / backwards or change the values of the parameters during "Setting Menu" screens. This Key is also used in conjunction with the "Enter" Key for selecting Power Save and Equalization Modes. Every time any of the Keys is pressed, a short beep will be heard
- **Set Key:** Is used to first open the "Setting Menu" and then to scroll the"Setting Menu"screens in the forward direction only. The "Setting Menu" consists of 10 screens as shown in **Section 7 titled "Setting Menu and Display Screens"**. The 10 "Setting Menu"screens can be scrolled one by one in the forward direction only in the form of a loop. For example, Screen 1 ⟶ 2 ⟶ 3 ⟶ 4… ⟶ 10 ⟶ 1 ⟶ 2 ⟶ … Please note that it is not possible to go to the previous screen of the "Setting Menu" by using the "Up" or "Down" Keys. In case a previous "Setting Menu" screen is required, it will be necessary to press the "Set Key" a number of times to scroll forward in the loop to get to the required screen.
  - Press for > 3 sec for opening the"Setting Menu". The "Setting Menu" starts with the first screen as shown in **Section 7 titled "Setting Menu and Display Screens"**. The Green Status LED and the Red Fault LED will start blinking to indicate that the unit is in the Setting Mode
  - Once the "Setting Menu" is opened, press Set Key once to scroll to the next "Setting Menu" screen.
  - A short beep will be heard every time the Set Key it is pressed
- **Enter Key:** Selects the desired value in the "Setting Menu" screens. This Key is also used in conjunction with the "Up" and "Down" Keys for selecting Power Save and Equalization Modes. A short beep will be heard every time the Enter Key is pressed
- **Status LED:** Green LED that can be OFF, ON - steady or ON –blinking to indicate the status of the unit. Please see Table 9.1 "LED Indications and Buzzer Condition for Normal Modes of Operation" and Table 9.2 "Protections" under Section 9.
- **Fault LED:** Red LED that can be OFF, ON - steady or ON – blinking and indicates fault condition.Please see Table 9.1 "LED Indications and Buzzer Condition for Normal Modes of Operation" and Table 9.2 "Protections" under Section 9.
- **Buzzer:** There is an internal buzzer that sounds a short beep signaling completion of pressing action of the various Keys and also provides audible warning for operational states and fault conditions. Please see Table 9.1 "LED Indications and Buzzer Condition for Normal Modes of Operation" and Table 9.2 "Protections" under Section 9.

SECTION 7 | Setting Menu and Display Screens

Setting Menu Screens

The "Setting Menu" is used to program various modes of operation and important operational parameters.

The "Set Key" is used to first open the "Setting Menu" and then to scroll the "Setting Menu" screens in the forward direction only. The "Setting Menu" consists of 8 screens as shown below. The 8 "Setting Menu" screens can be scrolled one by one in the forward direction only in the form of a loop. For example, Screen 1 ⟶ 2 ⟶ 3 ⟶ 4… ⟶ 8 ⟶1 ⟶ 2 … ⟶ Please note that it is not possible to go to the previous screen of the "Setting Menu" by using the "Up" or "Down" Keys. In case a previous "Setting Menu" screen is required, it will be necessary to press the "Set Key" a number of times to scroll forward in the loop to get to the required screen.

- Press for > 3 sec for opening the "Setting Menu". The "Setting Menu" starts with the first screen, Screen 1 as shown below. The Green Status LED and the Red Fault LED will start blinking to indicate that the unit is in the Setting Mode
- Once the "Setting Menu" is opened, press Set Key once to scroll to the next "Setting Menu" screen.
- A short beep will be heard every time the Set Key it is pressed
- The programmable modes / values within the available range can be chosen using the "Up" and "Down" Keys.
- Once the required value / mode is displayed, press the "Enter" Key to accept the value / mode. As soon as the "Enter" Key is pressed, the selected value / mode is entered in the memory and the "Setting Menu" is automatically closed and exited. Please note that if any correction is required to be made after pressing the "Enter" Key, the "Setting Menu" will have to be opened once again as explained above
- *Please note that once the "Setting Menu" is opened, only one parameter / mode can be programmed at one time. As soon as the "Enter" Key is pressed after selecting the required parameter / mode, the selected value / mode is entered in the memory and the "Setting Menu" is closed and exited. The "Setting Menu" will have to be opened once again to program another parameter / mode.*

SCREEN 1

Generator Mode = Enable / Disable (Default = Disable)

NOTE: Generator Mode in the Disabled condition will be displayed as "Utility Mode" in normal display

G	e	n	e	r	a	t	o	r		M	o	d	e	
					D	i	s	a	b	l	e			

OR

G	e	n	e	r	a	t	o	r		M	o	d	e	
					E	n	a	b	l	e				

SCREEN 2

Low Voltage Transfer =
80 ~ 95 VAC (Default = 85 VAC) - in steps of 1V

L	o	w		V	o	l	t	a	g	e				
T	r	a	n	s	f	e	r		x	x	x		V	a	c

SCREEN 3

High Voltage Transfer =
130 ~ 140 VAC (Default = 132 VAC) - in steps of 1V

H	i	g	h		V	o	l	t	a	g	e			
T	r	a	n	s	f	e	r		x	x	x		V	a	c

SCREEN 4

Battery Boost (Absorption) Voltage =
12V Battery: 14 ~ 16V (0.1V Steps); Default: 14V
24V Battery: 28 ~ 32V (0.2V Steps); Default: 28V

B	a	t	t	e	r	y		B	o	o	s	t		
V	o	l	t	a	g	e			x	x	.	x	V	d	c

SCREEN 5

Battery Float Voltage
12V Battery: 13 ~ 15V (0.1V Steps); Deafulat: 13.8V
24V Battery: 26 ~ 30V (0.2V Steps); Default: 27.6V

B	a	t	t	e	r	y		F	l	o	a	t		
V	o	l	t	a	g	e			x	x	.	x	V	d	c

SCREEN 6

Bulk Charging Current =
10 ~ 80A, each step 10A (Default = 10A) for G4-2012

Bulk Charging Current =
10 ~ 70A, each step 10A (Default = 10A) for G4-2524 and G4-3524

C	h	a	r	g	i	n	g		C	u	r	r	e	n	t
											x	x	A		

SCREEN 7

Battery temperature compensation =
- 3.0 ~ -5.0mV / °C / Cell (Default = - 4.0 mV / °C / cell)

B	a	t	.	t	e	m	p	.	c	o	m	p	.		
					-	4	.	0	m	v	/	c	e	l	l

SECTION 7 | Setting Menu and Display Screens

SCREEN 8
Equalization Voltage =
14 ~ 16 VDC for 12V battery (0.1V steps) / 28 ~ 32 VDC for 24V battery (0.2V steps) (Default at 15.3 VDC / 30.6 VDC)

E	q	u	a	l	i	z	a	t	i	o	n			
V	o	l	t	a	g	e			x	x	.	x	V	d	c

Explanation of the Setting Menu Screens

CAUTION!

As a generator may have wider frequency fluctuations, these fluctuations will be passed on to the load. Hence, when a generator is used as a source of transferred / bypassed AC power, the load will be forced to operate under wider frequency fluctuations that will not be controlled and the user should ensure that when "Generator Mode" is selected, the loads should be able to tolerate the frequency variations of the generator.

ATTENTION!

Le générateur pourrait avoir des fluctuations de hautes fréquences, et ces fluctuations serait passées à la charge. Ainsi, quand le générateur est utilisé comme source de puissance CA transferée, la charge serait obligée de fonctionner avec des fluctuations de fréquence qui seront pas controlées. Alors l'utilisateur doit assurer que la mode «Generator mode» est sélectionnée, et que les charges sont capables de tolèrer des variations de fréquences provenant du générateur.

SCREEN 1
Generator Mode = Enable / Disable (Default = Disable)

NOTE: Generator Mode in the Disabled condition will be displayed as "Utility Mode" in normal display.

G	e	n	e	r	a	t	o	r		M	o	d	e		
					D	i	s	a	b	l	e				

OR

G	e	n	e	r	a	t	o	r		M	o	d	e		
					E	n	a	b	l	e					

In off-grid and RV applications, a generator may be used to charge the batteries.

Generator Mode should be enabled when the AC input source is a generator. The voltage output of a generator is likely to have wider frequency fluctuations due to load variations as compared to very low frequency variations in the utility / grid AC power.

The default setting is Generator Disable (this mode is displayed and described as the "Utility Mode"). As the frequency of the utility AC power does not vary widely, the G4 Series has a narrower window of + 5 Hz and – 3 Hz to allow transfer / bypass of the utility power to the load and carry out battery charging. If a generator is used as the AC input power source and the G4 is set in "Utility Mode" and if the frequency variation of the generator is more than + 5 Hz / - 3 Hz, the G4 will not transfer / bypass the generator output to the load / charge the batteries.

When the "Generator Mode" is selected, the frequency and phase of the AC output of the inverter are synchronized with the output frequency and phase of the generator **but the value of the frequency is not considered for transfer purposes**. The inverter remains synchronized with the generator frequency at all times and the load also sees the actual frequency of the generator at all times. **Note: Charging will be interrupted during the period when generator frequency is not within the range of 45 - 65 Hz due to overload distortion. Please see page 14 for more details.**

If grid / utility power is being used, please select "Generator Mode – Disable" to enable synchronized transfer with a maximum permissible frequency deviation range of +5 / - 3 Hz. Please read details of operation in Generator Mode on pages 50 & 52 and in Utility Mode on pages 48 & 49.

SCREEN 2
Low Voltage Transfer =
80 ~ 95 VAC (Default = 85 VAC) - In steps of 1V

L	o	w		V	o	l	t	a	g	e					
T	r	a	n	s	f	e	r		x	x	x		V	a	c

The unit is designed to work as an un-interruptible Power Supply (UPS). As explained earlier, the unit always starts in the Inverter Mode. If on system power up, appropriate AC input power within the programmed

SECTION 7 | Setting Menu and Display Screens

upper and lower voltage limits is detected, the Transfer Relay is energized, the AC input is bypassed to the AC output to power the loads and the unit will start charging the batteries connected to it.

The lower limit of the AC input voltage at which the load is automatically transferred to the inverter can be programmed from 80 ~ 95 VAC. The default setting is 85 VAC.

SCREEN 3

High Voltage Transfer =
130 ~ 140 VAC (Default = 132 VAC) - In steps of 1V

H	i	g	h		V	o	l	t	a	g	e				
T	r	a	n	s	f	e	r		x	x	x		V	a	c

The unit is designed to work as an Un-interruptible Power Supply (UPS). As explained above, the unit always starts in the Inverter Mode. If on system power up, appropriate AC input power within the programmed upper and lower voltage limits is detected, the Transfer Relay is energized, the AC input is bypassed to the AC output to power the loads and the unit will start charging the batteries connected to it.

The upper limit of the AC input voltage at which the load is automatically transferred to the inverter can be programmed from 130 ~ 140 VAC. The default setting is 132 VAC.

SCREEN 4

Battery Boost (Absorption) Voltage =
12V Battery: 14 ~ 16V (0.1V Steps); Default: 14V
24V Battery: 28 ~ 32V (0.2V Steps); Default: 28V

B	a	t	t	e	r	y		B	o	o	s	t			
V	o	l	t	a	g	e			x	x	.	x	V	d	c

SCREEN 5

Battery Float Voltage =
12V Battery: 13 ~ 15V (0.1V Steps); Default: 13.8V
24V Battery: 26 ~ 30V (0.2V Steps); Default: 27.6V

B	a	t	t	e	r	y		F	l	o	a	t			
V	o	l	t	a	g	e			x	x	.	x	V	d	c

Depending upon the type of battery and the manufacturers' recommendations, the Boost (Absorption) and the Float voltages can be programmed as follows using the above two screens:

Parameter	12V Version		24V Version	
	Programmable Range	Default	Programmable Range	Default
Boost (Absorption) Voltage	14 to 16 VDC	14.4 VDC	28 to 32 VDC	28.8 VDC
Float Voltage	13 to 15 VDC	13.8 VDC	26 to 30 VDC	27.6 VDC

SCREEN 6

Bulk Charging Current =
10 ~ 80A, each step 10A (Default = 10A) for G4-2012
Bulk Charging Current =
10 ~ 70A, each step 10A (Default = 10A) for G4-2524 and G4-3524

C	h	a	r	g	i	n	g		C	u	r	r	e	n	t
											x	x	A		

The maximum charging current of a battery is normally limited to 10% of the Ah capacity of the battery at the 20 hour discharge rate C_{20}. Very high charging current will not return the full capacity and also may damage the battery plates due to overheating. The maximum permissible charging current will depend upon the design of the battery. Check with the manufacturer of the battery to confirm the maximum allowable charging current. The charging current can be programmed as follows:

Parameter	12V Version		24V Version	
	Programmable Range	Default	Programmable Range	Default
Bulk Charging Current	10 to 80A (Steps of 10A)	10A	10 to 70A (Steps of 10A)	10A

Please note that if an external charging source is also used to charge the batteries at the same time in parallel with the internal AC charger of the unit, the charging current of the internal AC charger will be controlled so that the total charging current of the external charger and the internal charger is = the programmed charging current. For example, if the programmed charging current is say 60A and the charging current of the external charger is 30A, the internal AC charger will output only 30A (Programmed setting of 60A – external charging current of 30A = 30A). Similarly, if the programmed setting is say 30A and the external charger is 50A, the internal AC charger will not provide any charging. Please read more details on charging through external charger under heading "Parallel Charging of Batteries Through External Charger, page 15."

SCREEN 7

Battery temperature compensation =
- 3.0 ~ -5.0m V / °C / Cell (Default = - 4.0 mV / °C / cell)

B	a	t	.	t	e	m	p	.	c	o	m	p	.		
					-	4	.	0	m	v	/	c	e	l	l

The chemical reactions inside the battery change with temperature. The cell voltage has a Negative Temperature Coefficient - the cell voltage drops with increase in temperature. Normally, the battery voltages are specified at a particular temperature, e.g. 25°C. G4 units come with Battery Temperature Sensor Model No. BTS-G4 (Fig 2.4, page 8) that senses the battery temperature & modifies the output voltage of the charger accordingly.

The Temperature Coefficient can be programmed from -3.0 m V / °C / cell to -5.0 m V / °C / cell. The default value is -4.0 m V / °C / cell for the sensor BTS-G4.

SECTION 7 | Setting Menu and Display Screens

SCREEN 8

Equalization Voltage =
14 ~ 16 VDC for 12V battery / 28 ~ 32 VDC for 24V battery
(Default at 15.3 VDC / 30.6 VDC)

E	q	u	a	l	i	z	a	t	i	o	n			
V	o	l	t	a	g	e			x	x	.	x	V	d	c

Equalization is a deliberate overcharge of the battery for a specified time period. Equalizing your batteries will reduce sulfation and help reach and maintain the peak capacity of the battery. An equalization charge should only be performed on vented, flooded (non-sealed or "wet") batteries and not on the sealed AGM / Gel Cell batteries and only as often as recommended by the battery manufacturer.

During normal charging, temperature and chemical imbalances prevent some cells from reaching full charge. These reduced capacity cells accelerate sulfation (the build up of Lead Sulfate on the battery plates) and decrease the Ampere-hour capacity of the battery. During equalization, the battery is intentionally held above the Gassing Voltage. Fully charged cells dissipate the charging energy by gassing while incompletely charged cells continue to charge. The rapid gassing that occurs during equalization also helps to recondition the battery. The gassing creates a stirring action, which reverses electrolyte stratification (the separation of the liquid electrolyte into layers of different acid concentrations). The stirring action also helps to break up any Lead Sulfate, which may remain after normal charging.

The desired Equalization Voltage can be programmed through this screen as follows:

	12V Version		24V Version	
Parameter	Programmable Range	Default	Programmable Range	Default
Equalization Voltage	14 to 16 VDC	15.3 VDC	28 to 32 VDC	30.6 VDC

As explained in **Section 4 titled "Battery Charging in G4 Series"**, G4 Series uses Adaptive Charging Algorithm for the Equalization Stage that automatically computes the Equalization Time.

Please refer to details under heading "4 Stage Charging Profile in Manually Activated Equalization Mode" on page 17 and Charging Curve in Fig. 4.2 on page 18 for the following explanation.

When Equalization is initiated manually, the charger will first execute Bulk Stage followed by Boost (Absorption) Stage. On completion of Boost Stage, the charger will execute Equalization Stage. After completion of Equalization Stage, the charger will enter Float Stage. The transitions will be as follows:

- Bulk Stage (Constant Current) ⟶ Boost (Absorption) Stage (Constant Voltage) ⟶ Equalization Stage (Constant Voltage) ⟶ Float stage (Constant Voltage).
- During the Bulk Stage, the charger will charge at the programmed Bulk Charge Current (See Setting Menu, SCREEN 6, page 41)
- A Software Timer is used to measure the time taken from the time the unit transfers to the Utility / Generator Mode until the battery charger reaches 0.3V below the Boost (Absorption) Voltage, then registered this time as time To. The following times are computed based on the time To:
  - Boost (Absorption) Time T1 = To x 0.5
  - Equalization Time T2 is then computed based on the following logic:

    T2 = T1 + 1 hr = 0.5 To + 1 hr; if T1 < 2 hrs

    T2 = T1 + 2 hrs = 0.5 To + 2 hrs; if 2 < T1 < 4 hrs

    T2 = T1 + 4 hrs = 0.5 To + 4 hrs; if T1 > 4 hrs
- When the battery reaches the programmed Boost (Absorption) Voltage (See Setting Menu, SCREEN 4, page 41), it transitions to the Boost (Absorption) Voltage and remains in this stage for the computed time T1.
- At the end of Boost (Absorption) Stage, it transitions to the programmed Equalization Voltage (See Setting Menu SCREEN 8, page 42).
  It remains in this stage for the computed time T2.
- At the end of Equalization Stage, the charger transitions to the programmed Float Voltage (See Setting Menu, SCREEN 5, page 41).

Display Screens

Display Screens In Inverter Mode

In case AC input power is not available or if available but is not within the programmed specifications of voltage and frequency, the load will be powered / transferred to the internal inverter.

The following 5 screens of information can be accessed in the Inverter Mode. The screens can be scrolled using the "Up" or "Down" Keys.

Please note that the up to down order of appearance of the screens shown below (Screen 1 ⟶ Screen 2 ⟶ Screen 3 ⟶ Screen 4 ⟶ Screen 5 ⟶ Screen 1 ⟶ Screen 2, etc.) is valid when using the "Up" Key. The order will be reversed (bottom to top i.e. Screen 5 ⟶ Screen 4 ⟶ Screen 3 ⟶ Screen 2 ⟶ Screen 1 ⟶ Screen 5 ⟶ Screen 4, etc.) if the "Down" Key is used. Please also note that the scrolling of the display screens is in a continuous loop.

SCREEN 1

Press "Up" Key to go to SCREEN 2

I	n	v	e	r	t	e	r		M	o	d	e			

SCREEN 2

Press "Up" Key to go to SCREEN 3

I	n	p	u	t		S	t	a	t	u	s				
		x	x	x	V	a	c			x	x	.	x	H	z

SECTION 7 | Setting Menu and Display Screens

SCREEN 3
Press "Up"Key to go to SCREEN 4

O	u	t	p	u	t		S	t	a	t	u	s		
		x	x	x	V	a	c			x	x	.	x	H	z

SCREEN 4
Press "Up"Key to go to SCREEN 5

O	u	t	p	u	t		P	o	w	e	r			
						x	x	x	x		W	a	t	t	s

OR if the output is > 1 KW, the power will be displayed in KW as follows:

											x	.	x	K	W

NOTE: Under overload conditions of ≥ 150%, power will be displayed as follows:
- G4-2012A: "Over 3.0 KW"
- G4-2524A: "Over 3.7 KW"
- G4-3524A: "Over 5.2 KW"

SCREEN 5

B	a	t	t	e	r	y		S	t	a	t	u	s		
				x	x	.	x	V	d	c					

Display Screens In Utility Mode

Utility Mode screens are displayed when AC input is available and "Generator Mode Disable" is selected from the Setting Mode Menu, Screen 1(Please note that selection "Generator Mode Disable" = Utility Mode).

The following 6 screens of information can be accessed in the Utility Mode.

The screens can be scrolled using the "Up" or "Down" Keys. Please note that the up to down order of appearance of the screens shown below (Screen 1 ⟶ Screen 2 ⟶ Screen 3 ⟶ Screen 4 ⟶ Screen 5 ⟶ Screen 6 ⟶ Screen 1 ⟶ Screen 2, etc.) is valid when using the "Up" Key. The order will be reversed (bottom to top i.e.
Screen 6 ⟶ Screen 5 ⟶ Screen 4 ⟶ Screen 3 ⟶ Screen 2 ⟶ Screen 1 ⟶ Screen 6 ⟶ Screen 5, etc.) if the "Down" Key is used. Please also note that the scrolling of the display screens is in a continuous loop.

SCREEN 1
Press "Up" Key to go to SCREEN 2

U	t	i	l	i	t	y		M	o	d	e	

SCREEN 2
Press "Up" Key to go to SCREEN 3

I	n	p	u	t		S	t	a	t	u	s			
		x	x	x	V	a	c			x	.	x	H	H	z

SCREEN 3
Press "Up" Key to go to SCREEN 4

O	u	t	p	u	t		S	t	a	t	u	s		
		x	x	x	V	a	c			x	x	.	x	H	z

SCREEN 4
Press "Up" Key to go to SCREEN 5

B	a	t	t	e	r	y		C	h	a	r	g	i	n	g
	x	x	x	A						x	x	.	x	V	

SCREEN 5
Press "Up" Key to go to SCREEN 6

		E	x	t	.					I	n	t	.		
					A								A		

SCREEN 6

C	h	a	r	g	i	n	g		M	o	d	e			
						B	u	l	K						

OR

C	h	a	r	g	i	n	g		M	o	d	e			
						B	o	o	s	t					

OR

C	h	a	r	g	i	n	g		M	o	d	e			
						F	l	o	a	t					

SECTION 7 | Setting Menu and Display Screens

Display Screens In Generator Mode

Generator Mode screens are displayed when AC input is available and "Generator Mode Enable" is selected from the Setting Mode Menu, Screen 1.

The following 6 screens of information can be accessed in the Generator Mode. The screens can be scrolled using the "Up" or "Down" Keys.

Please note that the up to down order of appearance of the screens shown below (Screen 1 ⟶ Screen 2 ⟶ Screen 3 ⟶ Screen 4 ⟶ Screen 5 ⟶ Screen 6 ⟶ Screen 1 ⟶ Screen 2, etc.) is valid when using the "Up" Key. The order will be reversed (bottom to top i.e. Screen 6 ⟶ Screen 5 ⟶Screen 4 ⟶ Screen 3 ⟶ Screen 2 ⟶ Screen 1 ⟶ Screen 6 ⟶ Screen 5, etc.) if the "Down" Key is used. Please also note that the scrolling of the display screens is in a continuous loop.

SCREEN 1

Press "Up" Key to go to SCREEN 2

G	e	n	e	r	a	t	o	r		M	o	d	e	

SCREEN 2

Press "Up" Key to go to SCREEN 3

I	n	p	u	t		S	t	a	t	u	s			
		x	x	x	V	a	c			x	.	x	H	H	z

SCREEN 3

Press "Up" Key to go to SCREEN 4

O	u	t	p	u	t		S	t	a	t	u	s			
		x	x	x	V	a	c			x	x	.	x	H	z

SCREEN 4

Press "Up" Key to go to SCREEN 5

B	a	t	t	e	r	y		C	h	a	r	g	i	n	g
	x	x	x	A						x	x	.	x	V	

OR

b	a	t	t	e	r	y		C	h	a	r	g	i	n	g
	I	n	p		H	z		A	b	n	o	r	m	a	l

NOTE: This screen will be displayed when the frequency of the generator is outside the range of 45 to 65 Hz. Charging is stopped during this condition.

SCREEN 5

Press "Up" Key to go to SCREEN 6

		E	x	t	.					I	n	t	.		
					A								A		

OR

		E	x	t	.					I	n	t	.		
					A							O	A		

NOTE: This screen will be displayed when the frequency of the generator is outside the range of 45 to 65 Hz. Charging is stopped during this condition.

SCREEN 6

C	h	a	r	g	i	n	g		M	o	d	e			
						B	u	l	K						

OR

C	h	a	r	g	i	n	g		M	o	d	e			
						B	o	o	s	t					

OR

C	h	a	r	g	i	n	g		M	o	d	e			
						F	l	o	a	t					

OR

C	h	a	r	g	i	n	g		M	o	d	e			
	I	n	p		H	z		A	b	n	o	r	m	a	l

NOTE: This screen will be displayed when the frequency of the generator is outside the range of 45 to 65 Hz. Charging is stopped during this condition.

SECTION 8 | Operation

CAUTION!

Overloading Of Inverter Due To Starting Surge Power Of AC Loads AC loads may be classified as resistive, capacitive or inductive. Depending upon the type, AC loads will consume momentary higher "surge power" on start up as compared to "running power" consumed during running condition. **For details, please read online White Paper titled "Inverters - General Information" at Samlex America website www.samlexamerica.com (Home > Support > White Papers).**

Some AC loads require very high starting power that may be more than 5 times the running power and may last for more than 1 sec. If the surge power of the AC load is more than the surge rating of G4 with respect to value and time, the G4 may shut down due to overload. The manufacturers' specification for power rating of AC appliances and devices indicates only the running power required. The surge power required has to be determined by actual testing or by checking with the manufacturer.

The Table below lists some common loads that require high surge power on start up and the surge may last for > 1 sec. A "Surge Factor" has been indicated against each, which is a multiplication factor to be applied to the running Watt rating of the load to arrive at the Surge Power demanded by the load. **Please ensure that surge power demanded by the AC load is less than the 150% overload rating of G4.**

Type of Device or Appliance	Surge Factor*
Air conditioner	5
Refrigerator / Freezer (Compressor based)	5
Air Compressor	4
Sump Pump / Well Pump / Submersible Pump	3
Dishwasher	3
Clothes Washer	3
Microwave (In cases where the rated output power is the cooking power)	2
Furnace Fan	3
Industrial Motor	3
Portable Kerosene / Diesel Fuel Heater	3
Circular Saw	3
Bench Grinder	3
Incandescent / Halogen / Quartz Lamps	3
Laser Printer / Other Devices using Quartz Lamps for heating	4
Switched Mode Power Supplies	3
Photographic Strobe / Flash Lights	4 Times Watt - Sec Rating
* Multiply the Running Power Rating (Watts / VA) of the appliance by this Factor to arrive at the Surge Power consumed on startup.	

ATTENTION!

La surcharge de l'onduleur dû à une puissance augmentée débutante. pour des charges CA.
Les charges CA sont classifiées: résistive, capacitive ou inductive. Dépendament de la classification, les charges CA vont consommer une «puissance augmentée» au démarrage comparé à la «puissance de fonctionnement» qui est utilisée pendant la fonctionnement.
Pour en savoir plus, veuillez lire le texte intitulé "Inverters - General Information" sur le site internet Samlex America www.samlexamerica.com (Home > Support > White Papers).

Certains charges CA ont besoin de la puissance forte au démarrage qui pourrais être jusqu'à 5 fois plus fort que la puissance de fonctionnement et qui peut durer plus q'une seconde. Si la puissance « augmentée » de la charge CA est plus fort/dure plus longtemps que la «classification surge » du G4, le G4 pourrais fermer dû à une surcharge. Les spécifications du fabricant pour la classification de puissance CA des appareils et dispositifs indiquent seulement la puissance nécessaire pour les faire marcher. La «puissance surge» requise est déterminé en faisant un test ou, en demandant au Fabricant.

La table en-dessous montre des charges communes qui sont alimentée avec une augmentation forte de puissance au démarrage, qui peut durer plus q'une seconde. Un facteur «surge» est indiquée pour chaque appareil, qu'il faut multiplier à la classification watts de fonctionnement de la charge pour calculer la puissance « surge » nécessaire pour alimenter l'appareil/dispositif.
Veuillez assurer que la puissance augmentée pour alimenter les charges est moins que 150% de la classification de surcharge G4.

Sorte de Dispositif ou Appareil	*Facteur d'augmentation**
Climatiseur	*5*
Réfrigérateur/Congélateur	*5*
Compresseur d'air	*4*
Pompe à Puisard/ Pompe à Puit / Pompe Sousmersible	*3*
Lave-vaisselle	*3*
Machine à Laver	*3*
Micro-onde (Au cas où la puissance de sortie est la puissance de cuisson)	*2*
Ventilateur d'une Chaudière	*3*
Moteur Industriel	*3*
Appareil de Chauffage Portable Alimenté par Diesel ou Kérosène	*3*
Scie Circulaire	*3*
Touret	*3*
Ampoules Incandescent/ Halogène/ Quartz	*3*
Imprimante Laser/ Autres dispositifs utilisant des Ampoule Quartz pour le Réchauffement	*4*
Alimentation à Découpage	*3*
Strobe photographique / Lumières Éclatantes:	*4 fois la classification Watt-Sec*
** Multiplier la classification de puissance de fonctionnement (Watts/vA) de l'appareil par ce facteur pour arriver à la puissance nécessaires pour le démarrage.*	

SECTION 8 | Operation

Switching ON the Unit

- Press the ON / OFF Key and hold in pressed condition for around 3 to 5 sec, till a beep is heard. Release the Key after the beep is heard
- As soon as the ON/OFF key is released, the G-4 starts in Inverter Mode and 120 VAC is made available at the output terminals. Due to "Soft Start Function," the output voltage ramps up from around 40V to 120V in around 350 ms.
- The LCD display will appear after around 2 to 3 sec after release of the Key and will display the Self Test Mode Screen as follows:

S	e	l	f	-	t	e	s	t		M	o	d	e

- At the same time, the unit carries out Self Test Mode for around 8 sec (includes nested Boot Detection Mode) to check necessary requirements and measurements. The Green Status LED and the Red Fault LED will blink around 8 times during the Self Test Mode. Further details of abnormal conditions detected during the Self Test Mode are given in the subsequent paragraphs
- After the Self Test Mode is completed successfully, there will be a short beep, and the Green Status LED and the Red Fault LED will stop blinking.
- Under normal operating conditions, the LCD display will indicate Utility Mode or Generator Mode or Inverter Mode Screen. Also, the Green Status LED will change to a pattern relative to the operating status as shown in "Tables 9.1, 9.2 & 9.3 in Section 9 titled "Protections, Operational Monitoring and Fault Diagnostics"

Switching OFF the Unit

- Press the On / Off Key and hold in pressed condition.
- The switching off routine is completed within about 3 to 5 sec and a beep is sounded on completion. **Release the Key after hearing the beep.**
- **Please note that if the fans were running at the time the unit is switched off, the fans may continue to run even after the unit is switched off to cool the unit down.**

Self-Test Mode

During the switching on procedure as described above, the unit carries out Self Test Mode that includes a nested Boot Detection Mode to include the following necessary requirements and measurements: The Green Status LED and the Red Fault LED will blink 1 @ 1 sec for around 8 sec / 8 times during the Self Test Mode:

- Checks if the AC input wires from the utility / grid / generator have been connected by mistake to the AC output connectors instead of the AC input connectors. If this mistake has been made in the AC wiring, the booting process is halted and the following error message is displayed. Correct the error and start again:

W	i	r	i	n	g		E	r	r	o	r		

CAUTION!

Please note that the above protection against error in connection of the AC input wiring is active only when this wrong connection is made when the unit is in OFF condition and is powered ON subsequently. If the AC input voltage from the utility / generator is erroneously connected / fed to the AC output connections when the unit is ON condition, the Inverter Section will be burnt instantaneously and may become a fire hazard. Hence, please ensure that the AC input voltage from the utility / generator is connected to the AC input terminals and not to the AC output terminals and that this connection is made only when the unit is in OFF condition.

- Checks the state of charge of the battery by measuring its terminal voltage. If the battery voltage is more than 5V and less than 9V (For 12V version) OR more than 10V and less than 18V (for 24V version), the battery is considered weak, the booting process is halted. Following symptoms will be seen:
  - Status LED - OFF
  - Fault LED - blinking 1 @ 0.5 seconds
  - Buzzer Alarm - 1 beep @ 0.5 seconds
  - The following error message is displayed:

B	a	t	t	e	r	y		W	e	a	k		

CAUTION! DO NOT PRESS THE ON/OFF KEY TO RESTART or switch OFF the unit. Disconnect AC input power and remove the DC input connection and disconnect the battery. Recharge the battery fully using another charger, if possible, or replace the battery with a new fully charged battery.

- Checks the state of charge of the battery by measuring its terminal voltage. If the battery voltage is less than 5V (For 12V version) OR less than 10V (for 24V version), the battery is considered not fit for charging and the booting process is halted. Also, checks if the battery is not connected or if the battery connection is broken. The booting process is halted if these conditions are detected.

  The following error message is displayed if any one of the above 3 conditions are detected. Following symptoms will be seen:
  - Status LED - OFF
  - Fault LED - ON constantly
  - Buzzer Alarm - ON constantly

  The following error message is displayed:

B	a	d		B	a	t	t	e	r	y			

SECTION 8 | Operation

In this case, the unit will not continue to boot even if the ON/OFF Key is pressed again. Disconnect AC input power and remove the DC input connection and disconnect the battery. Recharge the battery fully using another charger, if possible, or replace the battery with a new, fully charged battery.

ATTENTION!

La protection décrite à la section 5 est active seulement quand la mauvaise connexion est faite et si l'appareil est fermé et puis mis en marche. Si la tension d'entrée venant de l'utiliaire/générateur est lié, par erreur, aux bornes de sortie CA pendant que l'appareil est en marche, la section de l'onduleur serait brûlée instantanément et poserait une risque d'incendie. Alors, veuillez assurer que la tension d'entrée CA de l'utilitaire/générateur est connectée aux bornes d'entrée CA, pas aux bornes de sortie CA et, que la connexion est faite seulement quand l'appareil est fermé.

- *Le G4 vérifie l'état de la charge de la batterie en mesurant la tension aux bornes. Si la tension de la batterie est plus que 5V mais moins que 9V (Pour la version 12 V) ou plus que 10 V mais moins que 18 V (pour la version 24 V), la batterie est considèrer d'être faible et le processus de démarrage est affiabli. Les indications suivants vont apparaître:*
  - *DEL de statut- FERMER*
  - *DEL défaut- Clignote une fois @ 0,5 secondes*
  - *Alarme- Sonne une fois @ 0,5 secondes*
  - *Le message d'erreur suivant est affiché*

B	a	t	t	e	r	y		W	e	a	k			

ATTENTION! N'APPUYEZ PAS L'INTERRUPTEUR ON/OFF POUR RALLUMER ou FERMER l'appareil. Déconnectez la puissance d'entrée CA, enlevez la connexion d'entrée CA et puis déconnecter la batterie. Rechargez la batterie complètement en utilisant un autre chargeur, et si possible, remplacez la batterie avec une batterie qui est pleinement chargée.

- *Le G4 vérifie l'état de la charge de la batterie en mesurant la tension aux bornes. Si la tension de la batterie est moins que 5 V (la version de 12 V) ou moins que 10 V (pour la version de 24 V), la batterie n'est pas prête pour être charger et le processus de démarrage est arrêté. En plus, le G4 vérifie si la batterie n'est pas connectée ou si la connexion est brisée. Dans ce cas le processus de démarrage est arrêté.*
- *Le message d'erreur suivant est affiché si une des trois conditions au-dessus sont détectées. Les indications suivants vont apparaître:*
  - *DEL de statut- FERMER*
  - *DEL défaut- ALLUMER*
  - *Alarme- SONNE constanément*
  - *Le message d'erreur suivant est affiché*

B	a	d		B	a	t	t	e	r	y				

Dans ce cas, l'appareil ne va pas démarrer même si l'interrupteur ON/OFFest appuyé. Déconnectez la puissance d'entrée CA, enlevez la connexion d'entrée CA et puis déconnecter la batterie. Rechargez la batterie complètement en utilisant un autre chargeur, et si possible, remplacez la batterie avec une batterie qui est pleinement chargée.

Option To Check Input and Output Parameters During Self-Test Mode

During the Self Test Mode, the unit checks and records the Input Status (voltage and frequency), Output Status (voltage and frequency), Output Power (Watts / Kw) and Battery Status (voltage).

The following 5 screens of information can be accessed during the 8 sec period when the unit is in the "Self Test Mode".

The screens can be scrolled using the "Up" or "Down" Keys. Please note that the up to down order of appearance of the screens shown below (Screen 1 ⟶ Screen 2⟶ Screen 3 ⟶ Screen 4 ⟶ Screen 5 ⟶ Screen 1 ⟶ Screen 2, etc.) is valid when using the "Up" Key. The order will be reversed (bottom to top i.e. Screen 5 ⟶ Screen 4 ⟶ Screen 3 ⟶ Screen 2 ⟶ Screen 1 ⟶
Screen 5 ⟶ Screen 4, etc.) if the "Down" Key is used. Please also note that the scrolling of the display screens is in a continuous loop.

SCREEN 1

Press "Up" Key to go to SCREEN 2

S	e	l	f	-	t	e	s	t		M	o	d	e		

SCREEN 2

Press "Up" Key to go to SCREEN 3

I	n	p	u	t		S	t	a	t	u	s				
		x	x	x	V	a	c			x	x	.	x	H	z

SCREEN 3

Press "Up" Key to go to SCREEN 4

O	u	t	p	u	t		S	t	a	t	u	s			
		x	x	x	V	a	c			x	x	.	x	H	z

SECTION 8 | Operation

SCREEN 4
Press "Up" Key to go to SCREEN 5

O	u	t	p	u	t		P	o	w	e	r			
						x	x	x	x		W	a	t	t	s

OR if the output is > 1 KW, the power will be displayed in KW as follows:

											x	.	x	K	W

SCREEN 5

B	a	t	t	e	r	y		S	t	a	t	u	s		
				x	x	.	x	V	d	c					

Operation In Utility Mode (Generator Mode Disabled)

In this mode, the following input / output connections are made:

- The Utility power is connected to the AC Input terminals.
- The AC output terminals are connected to the AC distribution wiring
- The battery is connected to the Battery Input Terminals
- If a parallel external charging source (e.g. charge controller fed from solar array or another AC charger) is required to charge the batteries, it should be connected to the auxiliary DC input terminals

Select the "Utility Mode" through the Settings Menu (SCREEN 1, page 40).

NOTE: Please note that in the Settings Menu, "Utility Mode" is selected by selecting "Generator Disable".

Use this mode when the AC input source is utility / grid. As the frequency of the utility / grid AC power does not vary widely, the "Utility Mode"has a narrower window of + 5 Hz and – 3 Hz to allow transfer / bypass of the utility power to the load and carry out battery charging. This restricted frequency window is appropriate for safe and reliable operation of frequency sensitive loads.

The G4 Series comes preset in the "Utility Mode".

CAUTION!

Please do not operate in the "Utility Mode" if a generator is used as the AC input power source because if the frequency variation of the generator is more than + 5 Hz / - 3 Hz, the G4 will not transfer / bypass the generator output to the load / charge the batteries. If the output frequency of the generator is not stable and varies by +5 Hz / - 3 Hz, please operate the G4 in the "Generator Mode".

ATTENTION!

Veuillez ne pas utiliser la mode «Utility mode» si le générateur est utilisé comme source de puissance d'entrée CA parce que si la variation des fréquences du générateur est plus que 65 Hz ou moins que 57 Hz, le G4 ne peut pas transferer la sortie du générateur à la charge/recharger les batteries. Si la fréquence de la sortie du générateur n'est pas stable, est au-dessus/en-dessous de ces limites , veuillez faire fonctionner le G4 dans la mode «Generator mode».

Transfer From Inverter Mode To Utility Mode & Vice Versa

Whenever the G4 Series is switched on, it will always start in the "Inverter Mode" first even if external utility or generator input is available. The output of the inverter ramps up from around 40 VAC to 120 VAC in around 350 ms under "Soft Start" and is slowly synchronized with the frequency of the external utility / generator (if available) and the load is transferred / bypassed to the external utility / generator when fully synchronized and at the same time, the Battery Charger Section starts charging the batteries. This preparation time for ensuring synchronized transfer from the Inverter Mode to the Utility / Generator Mode may take around 20 to 30 sec (the actual transfer is completed within 20 ms). Transfer from the Inverter Mode to the "Utility Mode" will take place only under the following conditions:

- The voltage of the external utility is within the limits of low and high input voltages set through the Setting Mode (SCREENS 2, page 40 and SCREEN 3, page 41)
- The frequency of the external utility is within + 5 Hz and – 3 Hz

After the load has been successfully transferred to the utility, the Inverter Section is kept in standby condition and its output frequency and phase are kept synchronized with the phase and frequency of the utility to enable safe and faster transfer to the inverter for un-interrupted backup power.

If the utility power fails or if the voltage / frequency of the utility power deviates more than the programmed limits given above, the Transfer Relay de-energizes and the load is transferred to the inverter within the rated Transfer Time of 20 ms. After transfer has taken place, the inverter executes a soft start wherein its voltage is ramped up from around 40 VAC to the full rated voltage in a time span of around 350 ms. This soft start / ramp up of its output voltage reduces overloading of the inverter due to reduction in inrush current drawn by the load as a result of lower startup voltage.

If subsequently, the utility power returns and its voltage and frequency are within the programmed limits as given above, the load is once again transferred back to the utility as explained above.

SECTION 8 | Operation

NOTE: Loss of power for around 20 ms during transfer will show up as a slight flicker in incandescent lamps because the filament of incandescent lamp does not cool down immediately in such a short duration. However, a Compact Fluorescent Lamp (CFL) will switch off (its Holdup time is < 20 ms) and switch on again after some time because the drive circuitry of the lamp shuts down and takes some time to reactivate to re-light the lamp. Hence, this symptom in a CFL will falsely indicate a larger transfer time. Computers, audio video devices and other electronics normally have holdup time of > 20 ms and will not be affected by this short interruption of power.

LCD Display Screens And LED Display In The "Utility Mode"

INFO

The main Bi-directional Transformer is protected against over temperature during Battery Charging Mode by reducing the charging current to 50% if the transformer temperature > 120°C. Hence, during charging process, the internal charging current being displayed on the LCD display (SCREEN 4 and SCREEN 5) might drop to half the value when the temp > 120°C. Once the transformer cools down, the charging current will resume to the full value. This cycling may repeat a number of times till the transformer temperature does not rise > 120°C.

When in "Utility Mode", the Green Status LED will be steady and the following 6 LCD screens of information can be accessed in the Utility Mode. The screens can be scrolled using the "Up" or "Down" Keys.

Please note that the up to down order of appearance of the screens shown below (Screen1 ⟶ Screen 2 ⟶ Screen 3 ⟶ Screen 4 ⟶ Screen 5 ⟶ Screen 6 ⟶ Screen 1 ⟶ Screen 2, etc.) is valid when using the "Up" Key. The order will be reversed (bottom to top i.e. Screen 6 ⟶ Screen 5 ⟶ Screen 4 ⟶ Screen 3 ⟶ Screen 2 ⟶ Screen 1 ⟶ Screen 6 ⟶ Screen 5, etc.) if the "Down" Key is used. Please also note that the scrolling of the display screens is in a continuous loop.

SCREEN 1

Press "Up" Key to go to SCREEN 2

U	t	i	l	i	t	y		M	o	d	e	

SCREEN 2

Press "Up" Key to go to SCREEN 3

I	n	p	u	t		S	t	a	t	u	s			
		x	x	x	V	a	c			x	.	x	H	z

SCREEN 3

Press "Up" Key to go to SCREEN 4

O	u	t	p	u	t		S	t	a	t	u	s		
		x	x	x	V	a	c			x	x	.	x	H	z

SCREEN 4

Press "Up" Key to go to SCREEN 5

B	a	t	t	e	r	y		C	h	a	r	g	i	n	g
	x	x	x	A						x	x	.	x	V	

SCREEN 5

Press "Up" Key to go to SCREEN 6

	E	x	t	.					I	n	t	.		
					A								A	

SCREEN 6

C	h	a	r	g	i	n	g		M	o	d	e		
						B	u	l	K					

OR

C	h	a	r	g	i	n	g		M	o	d	e		
						B	o	o	s	t				

OR

C	h	a	r	g	i	n	g		M	o	d	e		
						F	l	o	a	t				

SECTION 8 | Operation

Generator Mode - General Information

In Generator Mode, the following input / output connections are made:

- The generator power is connected to the AC Input terminals.
- The AC output terminals are connected to the AC distribution wiring
- The battery is connected to the Battery Input Terminals
- If a parallel external charging source (e.g. charge controller fed from solar array or another AC charger) is required to charge the batteries, it should be connected to the auxiliary DC input terminals provided for connecting external battery charger / charge controller

Important Information On Using Generator As External AC Input Source

The AC output voltage of a generator is proportional to its rotational speed (RPM – Revolutions Per Minute) and to the amount of excitation current fed to its field windings. The frequency of the AC output voltage produced by the generator is proportional to the RPM of the engine and the number of poles used in the generator. The RPM of the generator is controlled and kept constant by the mechanical governor installed on the engine that is driving the generator. The output voltage of the generator is controlled by its electrical voltage regulator that controls the excitation current fed to its field windings. When an electrical load is applied to the generator, its output voltage tends to drop and the speed of the engine also tends to drop leading to drop in the output frequency and additional drop in the output voltage. The drop in the RPM of the engine is countered by the engine governor by feeding more fuel to the engine. The drop in output voltage of the generator is countered by the voltage regulator of the generator by increasing the current fed to the field windings. Similarly, when a load is removed from the generator, its output voltage tends to rise and the RPM of the engine also tends to rise leading to increase in the output frequency and additional increase in the output voltage. The increase in the RPM of the engine is countered by the engine governor by reducing the fuel supply to the engine. The rise in the output voltage of the generator is countered by the voltage regulator of the generator by decreasing the current fed to the field windings.

The mechanical governor and electrical voltage regulator have sensitivity of producing controlling action to correct a deviation of the controlled parameter. Higher sensitivity tends to produce oscillations around the controlled value. Hence, when these devices try to control very fast moving parameters, they will produce larger oscillations before settling down. The voltage regulator will tend to produce high voltage transients during this time. **These symptoms are seen during the start up and shut down of the engine-generator.**

For 60 Hz frequency of AC voltage, the engine speeds should be 3600 RPM for 2 pole, 1800 RPM for 4 pole and 1200 RPM for 6 pole generators.

When a generator is started, it is cold and it starts from 0 RPM and reaches the rated RPM within a finite time. Thus, during the initial period of ramping up from 0 RPM to the rated RPM, its frequency and output voltage will be fluctuating due to the regulating action of the mechanical governor and the electrical voltage regulator. As this happens in a very short duration, during this period, the output frequency will fluctuate and the output voltage will also fluctuate and will contain a lot of high voltage transients that are produced by the extremely fast regulating actions of the mechanical governor and the voltage regulator. These voltage and frequency fluctuations and high voltage transients can damage the AC loads that are fed from the generator. Also, the engine needs some time to warm up and stabilize in its mechanical operation. **Normally, the engine - generator should be warmed up for at least 10 minutes before loading the generator.**

The same fluctuations in frequency and voltage and appearance of high voltage transients will be seen at the output of the generator at the time of shutting down the engine.

CAUTION!

In view of the above, it is very important that all AC loads on the output of the generator are switched on only after around 10 minutes of generator starting to ensure that the engine and generator have warmed up sufficiently and that the generator is providing stable frequency and well regulated, cleaner, transient free output voltage to prevent damage to the AC loads / G4 series Inverter Charger. Similarly, the AC loads should be disconnected first before the engine is shut down.

ATTENTION!

C'est vraiement important que toutes les charges CA qui sont branchées au générateur sont mises en marche 10 minutes après que le générateur a démarré. Cela permet que le moteur et le générateur sont bien réchauffé et que le générateur fourni une fréquence stable et une tension de sortie sans transition, bien reglé/propre qui empêche d'endommager les charges CA /le G4. Sembablement, les charges CA devraient être déconnecter avant que le moteur soit fermé.

Operation In Generator Mode

This mode of operation is selected through the Settings Menu **(SCREEN 1, page 40)**.

This mode is recommended to be used when the AC input source is a generator. As explained above, the voltage output of a generator is likely to have wider frequency fluctuations due to load variations as compared to very low frequency variations in the utility / grid AC power.

The G4 Series comes preset in the "Utility Mode" (Generator Mode disabled). As the frequency of the utility / grid AC power does not vary

widely, the G4 Series has a narrower window of + 5 Hz and – 3 Hz to allow transfer / bypass of the utility power to the load and carry out battery charging. If a generator is used as the AC input power source and the G4 is set in "Utility Mode" and if the frequency variation of the generator is more than + 5 Hz / - 3 Hz, the G4 will not transfer / bypass the generator output to the load / charge the batteries.

When "Generator Mode" is selected, the frequency and phase of the AC output of the inverter are synchronized with the output frequency and phase of the generator but the value of frequency is not considered for transfer purposes. The inverter remains synchronized with the generator frequency at all times and the load also sees the actual frequency of the generator at all times.

Automatic Interruption of Battery Charger Current In Generator Mode When Generator Frequency is Outside the Range of 45 Hz to 65 Hz

Please refer to detailed information under "Principle of Operation" in Section 4, page 14 under heading "Automatic Reduction in Battery Charger Current in Generator Mode When Generator Frequency is Outside the Range of 45 Hz to 65 Hz.""

In G4 Series, protection is provided to limit generator voltage distortion to acceptable limits. When the batteries are being charged at higher charging current, the generator has to deliver proportionately higher current that produces higher frequency deviation and waveform distortion in the output waveform of the generator that may lead to high voltage transients, spurious zero crossings, errors in frequency determination and loss of synchronization. When the frequency of the generator is outside the range of 45 Hz to 65 Hz, the control logic will stop charging to reduce distortion. The Display Screens "Battery Charging" (SCREEN 4, page 52) and "Charging Mode" (SCREEN 6, page 52) will show message "Inp Hz Abnormal". Also, Display Screen showing Internal (Int) and External (Ext) charging Amps (SCREEN 5, page 52) will display OA against Internal (Int) charger.

The charging will be resumed once the frequency of the generator is within the window of 45 Hz to 65 Hz.

⚠ CAUTION!

As a generator may have wider frequency fluctuations, these fluctuations will be passed on to the load. Hence, when a generator is used as a source of transferred / bypassed AC power, the load will be forced to operate under wider frequency fluctuations that will not be controlled and the user should ensure that when "Generator Mode" is selected, the loads should be able to tolerate the frequency variations of the generator.

⚠ *ATTENTION!*

Le générateur pourrait avoir des fluctuations de hautes fréquences, et ces fluctuations serait passées à la charge. Ainsi, quand le générateur est utilisé comme source de puissance CA transferée, la charge serait obligée de fonctionner avec des fluctuations de fréquence qui seront pas controlées. Alors l'utilisateur doit assurer que la mode «Generator mode» est sélectionnée, et que les charges sont capables de tolèrer des variations de fréquences provenant du générateur.

Transfer From Inverter Mode to Generator Mode & Vice Versa

Whenever the G4 Series is switched ON, it will always start in Inverter Mode first even if generator or utility input is available. The output of the inverter ramps up from around 40 VAC to 120 VAC in around 350 ms under "Soft Start" and is slowly synchronized with the frequency of the generator and the load is transferred / bypassed to the generator when fully synchronized and at the same time, the Battery Charger Section starts charging the batteries in parallel with the external charger, if connected. This preparation time for ensuring synchronized transfer from the Inverter Mode to the Generator Mode may take around 20 to 30 sec (the actual transfer is completed within 20 ms). The transfer from the Inverter Mode to the Generator Mode will take place only if the voltage of the generator is within the limits of low and high input voltages set through the "Setting Mode"(SCREEN 2, page 40 and SCREEN 3, page 41). **The value of the frequency is not considered for transfer purposes.**

After the load has been successfully transferred to the generator, the Inverter Section is kept in standby condition and its output frequency and phase are kept synchronized with the phase and frequency of the generator to enable safe and faster transfer to the inverter for uninterrupted backup power.

If the output of the generator fails or if the voltage of the generator deviates more than the programmed limits given above, the Transfer Relay de-energizes and the load is transferred to the inverter within the rated Transfer Time of 20 ms. After transfer has taken place, the inverter executes a soft start wherein its voltage is ramped up from around 40 VAC to the full rated voltage in a time span of around 350 ms. This soft start / ramp up of its output voltage reduces overloading of the inverter due to reduction in inrush current drawn by the load of the load as a result of lower startup voltage.

If subsequently, the output voltage of the generator returns to within the programmed limits, the load is once again transferred back to the generator as explained above.

NOTE: Loss of power for around 20 ms during transfer will show up as a slight flicker in incandescent lamps because the filament of incandescent lamp does not cool down immediately in such a short duration. However, a Compact Fluorescent Lamp (CFL) will switch off (its Holdup time is

< 20 ms) and switch on again after some time because the drive circuitry of the lamp shuts down and takes some time to reactivate to re-light the lamp. Hence, this symptom in a CFL will falsely indicate a larger transfer time. Computers, audio video devices and other electronics normally have holdup time of > 20 ms and will not be affected by this short interruption of power.

LCD Screens And LED Display In The "Generator Mode"

INFO

The main Bi-directional Transformer is protected against over temperature during Battery Charging Mode by reducing the charging current to 50% if the transformer temperature > 120°C. Hence, during charging process, the internal charging current being displayed on the LCD display might drop to half the value when the temp > 120°C. Once the transformer cools down, the charging current will resume to the full value. This cycling may repeat a number of times till the transformer temperature does not rise > 120°C.

When in "Generator Mode", the Green Status LED will be steady.

The following 6 LCD screens of information can be accessed in the "Generator Mode". The screens can be scrolled using the "Up" or "Down" Keys.

Please note that the up to down order of appearance of the screens shown below (Screen 1 ⟶ Screen 2⟶ Screen 3 ⟶Screen 4 ⟶ Screen 5 ⟶ Screen 6⟶ Screen 1⟶ Screen 2, etc.) is valid when using the "Up" Key. The order will be reversed (bottom to top i.e. Screen 6 ⟶ Screen 5⟶ Screen 4 ⟶ Screen 3⟶ Screen 2 ⟶ Screen 1 ⟶ Screen 6 ⟶ Screen 5, etc.) if the "Down" Key is used. Please also note that the scrolling of the display screens is in a continuous loop.

SCREEN 1

Press "Up" Key to go to SCREEN 2

G	e	n	e	r	a	t	o	r		M	o	d	e

SCREEN 2

Press "Up" Key to go to SCREEN 3

I	n	p	u	t		S	t	a	t	u	s			
		x	x	x	V	a	c			x	.	x	H	H	z

SCREEN 3

Press "Up" Key to go to SCREEN 4

O	u	t	p	u	t		S	t	a	t	u	s		
		x	x	x	V	a	c			x	x	.	x	H	z

SCREEN 4

Press "Up" Key to go to SCREEN 5

B	a	t	t	e	r	y		C	h	a	r	g	i	n	g
	x	x	x	A						x	x	.	x	V	

OR

B	a	t	t	e	r	y		C	h	a	r	g	i	n	g
	I	n	p		H	z		A	b	n	o	r	m	a	l

NOTE: This screen will be displayed when the frequency of the generator is outside the range of 45 to 65 Hz. Charging is stopped during this condition.

SCREEN 5

Press "Up" Key to go to SCREEN 6

		E	x	t	.					I	n	t	.		
					A								A		

OR

		E	x	t	.					I	n	t	.		
					A							O	A		

NOTE: This screen will be displayed when the frequency of the generator is outside the range of 45 to 65 Hz. Charging is stopped during this condition.

SCREEN 6

C	h	a	r	g	i	n	g		M	o	d	e		
						B	u	l	K					

OR

C	h	a	r	g	i	n	g		M	o	d	e		
						B	o	o	s	t				

OR

C	h	a	r	g	i	n	g		M	o	d	e		
						F	l	o	a	t				

OR

C	h	a	r	g	i	n	g		M	o	d	e		
	I	n	p		H	z		A	b	n	o	r	m	a	l

NOTE: This screen will be displayed when the frequency of the generator is outside the range of 45 to 65 Hz. Charging is stopped during this condition.

SECTION 8 | Operation

Operation In Inverter Mode

In "Inverter Mode" the following input / output connections are made:

- As AC input power is NOT available, nothing is connected to the AC Input terminals.
- The AC output terminals are connected to the AC distribution wiring
- The battery is connected to the Battery Input Terminals
- If a parallel external charging source (e.g. charge controller fed from solar array or another AC charger) is required to charge the batteries, it should be connected to the auxiliary DC input terminals

LCD Screens and LED Display in Inverter Mode

When in "Inverter Mode", the Green Status LED will be blinking – 1 blink @ 2 sec. The following 5 LCD screens of information can be accessed in the "Inverter Mode". The screens can be scrolled using the "Up" or "Down" Keys.

Please note that the up to down order of appearance of the screens shown below (Screen 1 ⟶ Screen 2⟶ Screen 3 ⟶Screen 4 ⟶ Screen 5 ⟶ Screen 6⟶ Screen 1⟶ Screen 2, etc.) is valid when using the "Up" Key. The order will be reversed (bottom to top i.e. Screen 6 ⟶ Screen 5⟶ Screen 4 ⟶ Screen 3⟶ Screen 2 ⟶ Screen 1 ⟶ Screen 6 ⟶ Screen 5, etc.) if the "Down" Key is used. Please also note that the scrolling of the display screens is in a continuous loop.

SCREEN 1
Press "Up" Key

I	n	v	e	r	t	e	r		M	o	d	e	

SCREEN 2
Press "Up" Key

I	n	p	u	t		S	t	a	t	u	s			
		x	x	x	V	a	c			x	x	.	x	H	z

SCREEN 3
Press "Up" Key

O	u	t	p	u	t		S	t	a	t	u	s			
		x	x	x	V	a	c			x	x	.	x	H	z

SCREEN 4
Press "Up" Key

O	u	t	p	u	t		P	o	w	e	r			

						x	x	x	x		W	a	t	t	s

OR if the output is > 1 KW, the power will be displayed in KW as follows:

				x	.	x	K	W

SCREEN 5
Press "Up" Key

B	a	t	t	e	r	y		S	t	a	t	u	s	
				x	x	.	x	V	d	c				

Equalizing Batteries

Equalization Procedure - Safety Instructions

WARNING!

Please note that equalization generates explosive gas mixture of Hydrogen and Oxygen. Ensure that during equalization, the area where the battery is installed has adequate ventilation to extract / dissipate the explosive gas mixture.

CAUTION!

Sealed AGM / Gel Cell batteries must NEVER be equalized. These types of batteries may fail prematurely if equalized. As a general rule, do not equalize a battery unless there are vented removable caps for the cells to add water to the cells of the battery.

SECTION 8 | Operation

Processus d'Égalization - Consignes de sécurités

ATTENTION!

Veuillez noter que l'égalisation produise de l'hydrogène et de l'oxygène, mélange de gaz explosif. Il faut assurer qu'il y a suffisament de ventilation, où la batterie est installée, pour disperser le gaz pendant l'égalisation.

ATTENTION!

Des batteries scellées (AGM) ou cellulles gelées devrait jamais être égalisées. Elles peuvent échouer, si elles sont égalisées. Un règle général, ne jamais égaliser une batterie sauf si elles ont des capuchons amovible, ventillée, afin que les cellules puisses ajouter de l'eau aux cellules de la batterie.

Equalization Procedure - General Instructions

a) Please read information in Section 4, page 17 under heading "4 Stage Charging Profile in Manually Activated Equalization Mode."

b) Please ensure that before the batteries are equalized, they should be deeply discharged to ≥ 80% capacity. The Standing Voltage (Terminal Voltage after disconnecting charging sources[s] and load[s] for at least 3 hours) at ≥ 80% discharge will be:

- 12V Battery: Around 11.7V
- 24V Battery: Around 23.4V

Do not equalize partially or fully charged batteries.

c) Follow the recommendations of the battery manufacturer for equalizing the batteries as the equalization voltage and time will depend upon the specific design of the battery. As a guide, a heavily used flooded battery may need to be equalized once per month and a battery in light duty service, every two to four months. If performed too frequently, or done improperly, equalization can be hazardous to the health of the batteries. Never equalize a battery more than necessary.

d) Turn off or disconnect all DC loads connected to the battery during equalization. Higher voltage applied to the battery during equalization may exceed the safe levels for some DC fed electronic loads like inverters and radios etc and this higher voltage can damage DC fed electronic loads. Also, equalization will not be fully effective if additional loads are drawing current from the batteries at that time.

e) Be sure to check battery electrolyte level. Fill only with distilled water if the electrolyte level is low.

f) Use a battery hydrometer to measure specific gravity of each cell. For lead-acid batteries that are fully charged, the reading should be approximately 1.265 (consult your battery manufacturer for the exact value).

g) Equalization is needed if one or more cells have substantially lower specific gravity than the others.

Equalization Procedure

To start the equalization charging cycle, the G4 must already be in operation in the "Utility or Generator Mode".

The G4 has an option to manually equalize the batteries, if desired. **Equalization voltage is programmable.** Please see details under Section 7 "Setting Menu & Screens, Screen 8," page 42.

As explained under heading "4 Stage Charging Profile in Manually Activated Equalization Mode" on page 16, G4 Series uses Adaptive Charging Algorithm for the Equalization Cycle that automatically computes the Equalization time.

Equalization can be switched on or switched off **manually** with the help of the Control Panel as follows:

- **Switching ON equalization:** To switch ON, press the "Enter" and "Down" Keys simultaneously for 2 seconds. Equalization will be carried out at the programmed voltage selected through "SCREEN 8, page 42".
- **Switching OFF equalization:** Pressing any Key for 2 sec will force equalization (if in progress) to switch OFF. When switched OFF in this manner, equalization for the balance period of the programmed duration of equalization will not be carried out.

As explained in detail under heading "4 Stage Charging Profile in Manually Activated Equalization Mode" on page 17, when equalization is initiated manually, the charger will first execute Bulk Stage followed by Boost (Absorption) Stage. On completion of Boost Stage, the charger will execute Equalization Stage. After completion of Equalization Stage, the charger will enter Float Stage.
The transitions will be as follows:

- Bulk Stage (Constant Current) ⟶ Boost (Absorption) Stage (Constant Voltage) ⟶ Equalization Stage (Constant Voltage) ⟶ Float stage (Constant Voltage).

The following screens will be display the stage the in which the charger is during the time equalization is in progress.

When in Bulk Stage during Equalization Mode

B	a	t		E	q	u	a	l	i	z	a	t	i	o	n
x	x	.	x	V	d	c				B	U	l	k		

SECTION 8 | Operation

When in Boost (Absorption) Stage during Equalization Mode

B	a	t		E	q	u	a	l	i	z	a	t	i	o	n
x	x	.	x	V	d	c				B	O	O	S	T	

When in Equalization during Equalization Mode

B	a	t		E	q	u	a	l	i	z	a	t	i	o	n
x	x	.	x	V	d	c				x*	x*	.	x*	x*	

* Here, the equalization time T2 that is remaining is indicated.

INFO

During Equalization Stage, The LCD will continue to display only one of the above 3 Screens depending upon the stage within the Equalization Cycle

(As explained above, when the Equalization Cycle is started, the unit will enter Bulk followed by Boost followed by Equalization and then exit to Float. Pressing Up and Down Keys will not change the Screen as is possible in the Utility / Generator / Inverter Modes.

Operation in Power Save Mode

Please read details of Power Save Mode at pages 10 & 11 in Section 3 titled "General Description and Principles of Operation."

Activation Of Power Save Mode

Power Save Mode is activated by pressing the "Enter" and "UP" Keys for around 2 second till following display appears and release the Keys:

P	o	w	e	r		S	a	v	e		M	o	d	e	
					E	n	a	b	l	e					

After around 8 sec, a short beep will be heard and the display will show as follows indicating the activation of the Power Save Mode:

P	o	w	e	r		S	a	v	e		M	o	d	e	

When the inverter is operating in the "Power Save Mode", the Green Status LED blinks once @ 4 sec.

When in the Power Save Mode, if the "UP" and "Down"Key is pressed, the screen will indicate the battery status as follows and will revert back to the Power Save Screen if the Up or Down Key is pressed again

P	o	w	e	r		S	a	v	e		M	o	d	e	

Press "Up" or "Down" Key

B	a	t	t	e	r	y			S	t	a	t	u	s	
				x	x	.	x	V	d	c					

Press "Up" or "Down" Key

P	o	w	e	r		S	a	v	e		M	o	d	e	

De-Activation Of Power Save Mode

Power Save Mode is de-activated by pressing the "Enter" and "UP" Keys for around 2 second still the following display appears and then releasing the Keys:

P	o	w	e	r		S	a	v	e		M	o	d	e	
					D	i	s	a	b	l	e				

After around 1 sec, a short beep will be heard and the display will exit the Power Save Mode.

Over Temperature Protection During Charging

The main Bi-directional Transformer is protected against over temperature during Battery Charging Mode by reducing the charging current to 50% if the transformer temperature > 120°C. **Hence, during charging process, the internal charging current being displayed on the LCD display might drop to half the value when the temp > 120°C. Once the transformer cools down, the charging current will resume to the full value. This cycling may repeat a number of times till the transformer temperature does not rise > 120°C.**

SECTION 9 | Protections, Operational Monitoring & Fault Diagnosis

As explained in Section 6 titled "LCD Control Panel for Local and Remote use", the LCD Control Panel is used to configure and monitor the operation of the unit.

LCD display and messages pertaining to control and monitoring of normal operation of the unit have been explained in the previous sections.

The LCD panel also displays alphanumeric information regarding fault conditions for diagnostics. In addition, the panel has 2 LEDs marked "Status" and "Fault" and an internal buzzer. These are also used for indicating the modes of operation of the unit and fault diagnostics using the following conditions:

- ON/OFF state of the 2 LEDs
- Color and blinking pattern of the 2 LEDs.
- Buzzing pattern of the buzzer

LED And Buzzer Indications For Normal Operating Modes

LEDs marked "Status" and "Fault" and an internal buzzer are used to indicate normal modes of operation as given in Table 9.1 below:

TABLE 9.1: LED INDICATIONS AND BUZZER CONDITION FOR NORMAL MODES OF OPERATION

Parameter	"Status" LED GREEN	"Fault" LED RED	Buzzer Condition	Remarks
UTILITY MODE	ON	OFF	1 beep after load is transferred	
GENERATOR MODE	ON	OFF	1 beep after load is transferred	
SETTING MODE	Blinking 1 @ 1 sec	Blinking 1 @ 1 sec	OFF	
INVERTER MODE	Blinking 1 @ 2 sec	OFF	1 beep after load is transferred	
POWER SAVE MODE	Blinking 1 @ 4 sec	OFF	OFF	
SELF-TESTING	Blinking 1 @ 1 sec	Blinking 1 @ 1 sec	OFF	At start up. Lasts for approximately 8 seconds
PRESSING OF KEY PAD IS BEING CONFIRMED	No change	No change	1 beep	

SECTION 9 | Protections, Operational Monitoring & Fault Diagnosis

Shut Down Due To Fault Conditions & Reset

CAUTION! Please note that "shut down" indicates that the output has been stopped. The unit will not completely turn OFF under "shut down" condition.

The unit will shut down in certain critical fault conditions and will require manual reset. Switch OFF the unit using the ON/OFF key. Remove the cause of defect and switch ON the unit again.

In some cases, the unit may get latched and will not switch OFF. In such cases, remove the AC & DC input connection, wait for 5 minutes, reconnect and then switch ON.

Protections

Table 9.2 gives the details of protections provided for safe and reliable operation of the unit:

TABLE 9.2: PROTECTIONS

SYMPTOM	"Status" LED - GREEN	"Fault" LED - RED	Buzzer Alarm	Remarks
Low DC input voltage protection - alarm (Inverter Mode) 11.0 VDC ± 0.3 VDC for 12V battery 22.0 VDC ± 0.6 VDC for 24V battery	Blinking 1 @ 2 sec	Blinking 1 @ 0.5 sec	3 beeps per 30 sec	
Low DC input voltage protection – shut down Inverter Section / (Inverter Mode) 10.0VDC ± 0.3VDC for 12V battery 20.0VDC ± 0.6VDC for 24V battery	OFF	OFF		OFF
High DC output voltage of internal AC charger (In Utility / Generator Mode) **In normal 3 Stage Charging Mode:** • Voltage > programmed Boost (Absorption) Voltage ± 0.3V (12V battery) • Voltage > programmed Boost (Absorption) Voltage ± 0.6V (24V battery) **In 4 Stage Equalization Mode** • Voltage > programmed Equalization Voltage ± 0.3V (12V battery) • Voltage > programmed Equalization Voltage ± 0.6V (24V battery)	OFF	ON	1 beep @ 0.5 sec	Charger is turned OFF
High DC output voltage of internal AC charger for 30 seconds protection (In Utility / Generator Mode) **In normal 3 Stage Charging Mode:** • Voltage > programmed Boost (Absorption) Voltage + 0.8 ± 0.3V (12V battery) • Voltage > programmed Boost (Absorption) Voltage + 1.6 ± 0.6V (24V battery) **In 4 Stage Equalization Mode** • Voltage > programmed Equalization Voltage + 0.6 V ± 0.3V (12V battery) • Voltage > programmed Equalization Voltage + 1.2 V ± 0.6V (24V battery)	OFF	Blinking	3 beeps @ 5 sec	• Charger is turned OFF • Unit transfers to Inverter Mode

SECTION 9 | Protections, Operational Monitoring & Fault Diagnosis

TABLE 9.2: PROTECTIONS

SYMPTOM	"Status" LED - GREEN	"Fault" LED - RED	Buzzer Alarm	Remarks
Excessive charging current: - 95A for G4-2012 - 85A for G4-2524 - 85A for G4-3524 (Utility / Generator Mode)	OFF	ON	Constantly on for 5 minutes	• Charger is turned OFF • No display message
110% overload of Inverter Section (Inverter Mode)	Blinking 1 @ 2 sec	ON	1 beep @ 0.5 sec	• Output shuts down after 15 mins • LCD displays "Fault Mode 110% Overload"
130% overload of Inverter Section (Inverter Mode)	Blinking 1 @ 2 sec	ON	Constantly ON	• Output shuts down after 60 sec • LCD displays "Fault Mode, 130% Overload"
150% overload of Inverter Section (Inverter Mode)	Blinking 1 @ 2 sec	ON	Constantly ON	• Output shuts down after 20 secs • LCD displays "Fault Mode, 150% Overload"
200% overload of Inverter Section (Inverter Mode)	OFF	ON	Constantly on for 5 minutes	• LCD display "Fault Mode, Fault Mode"
Short circuit of AC output side (Inverter Mode)	OFF	ON	Constantly on for 5 minutes	• Output shuts down immediately: LCD Displays "Fault Mode, Short Circuit" • Will restore output if short circuit lasts for < 10 secs • ON/OFF key will not operate • To reset, disconnect AC & DC input power and reconnect
Over temperature of heat sink for H-bridge Mosfets - Heat Sink temperature is ≥ 105°C for 30 secs	ON	ON	Constantly on for 5 minutes	• Output shuts down • LCD Displays "Fault Mode Over Temperature"
Over temperature of heat sink for H-bridge Mosfets - Heat Sink temperature is ≥ 140°C	OFF	ON	Constantly on for 5 minutes	• Output shuts down immediately • LCD Displays "Fault Mode Over Temperature"
Over temperature of Bi-directional Transformer windings: - Winding temperature is ≥ 140°C	OFF	ON	Constantly on for 5 minutes	• Output shuts down immediately • LCD Displays "Fault Mode Over Temperature"
Winding temperature is ≥ 120°C (Utility / Generator Mode)	ON	ON	Constantly on for 5 minutes	Reduce charging current to 50%
Battery Weak	OFF	Blinking 1 @ 0.5 sec	1 beep @ 0.5 sec	• LCD displays "Weak Battery" • **CAUTION!** Do not press the ON/OFF Key • Disconnect AC input power • Disconnect DC input connection • Recharge battery using external charger or replace battery • Reconnect battery and AC input power

SECTION 9 | Protections, Operational Monitoring & Fault Diagnosis

TABLE 9.2: PROTECTIONS				
SYMPTOM	**"Status" LED - GREEN**	**"Fault" LED - RED**	**Buzzer Alarm**	**Remarks**
Bad Battery: i) DC input voltage < 5V for G4-2012A or < 10V for G4-2524A/G43524A ii) External DC input fuse blown due to over-load / reverse polarity (AC input is available) **CAUTION! Reverse polarity is likely to cause permanent damage and is not covered by warranty.**	OFF	ON	Constantly ON	• LCD displays "Bad Battery" • Disconnect AC input power • Disconnect DC input connection • Recharge battery using external charger/replace battery / fuse • Reconnect battery and AC input power
Wiring Error	OFF	ON	Constantly ON	• LCD displays "Wiring Error" • AC input wiring from Utility / Generator wrongly connected to AC output terminals • Connect wiring correctly

Protections And Fault Diagnostics Provided By The LCD Alphanumeric Display

Details of diagnostic alphanumeric messages displayed on the LCD related to critical shut down due to fault conditions are given in Table 9.3 below. More details on the thresholds for activation of these shut down conditions and associated LED / buzzer activations are given in Table 9.2 on page 57 to 59. When the unit shuts down, it will be required to be reset manually. To reset, switch OFF the unit, remove the cause of the defect and switch ON again.

In some cases, the unit may get latched and will not switch OFF. In such cases, remove the DC & AC input connections, wait for 5 minutes, reconnect and then switch ON.

TABLE 9.3: PROTECTIONS AND ASSOCIATED LCD DISPLAY MESSAGES	
Short circuit on AC output side in Utility / Generator Mode	AC input gets disconnected due to tripping of Circuit Breaker marked "Charger" (40A for G4-2012 and G4-2524 and 60A for G4-3524). Pass-through load will be transferred to the Inverter Section. Inverter Section will shut down due to electronic short circuit protection. • LCD displays: " Fault Mode, Short Circuit"
Short circuit in Charger Section in Utility / Generator Mode	The unit will shut down due to electronic short circuit protection if short circuit lasts for > 10 sec: • Transfer Relay will be de-energized: • Charging will be stopped • AC by-pass output will be shut down • LCD displays: Fault Mode, Short Circuit"
Short circuit on AC output side in Inverter Mode	Inverter will shut down due to electronic short circuit protection if short circuit condition lasts for > 10 sec. • LCD displays: " Fault Mode, Short Circuit"

SECTION 9 | Protections, Operational Monitoring & Fault Diagnosis

TABLE 9.3: PROTECTIONS AND ASSOCIATED LCD DISPLAY MESSAGES

Continuous overload > the capacity of circuit Breaker marked "Load" in Utility / Generator Mode: 30A for G4-2012A 35A for G4-2524A 40A for G4-3524A	Circuit Breaker marked "Load" will trip and charging will stop: • Display in Utility / Generator Modes - "SCREEN 6" (pages 43 & 44) will show the charging stage at the time the breaker tripped • Display in Utility / Generator Modes - "SCREEN 4" (page 43) will show 0A and 0V • Display in Utility / Generator Modes - "SCREEN 5" (page 43) will show 0A for internal charger • Transfer Relay will remain energized. Pass-through AC output will still be available through the AC input breaker marked "Charger" If AC input is subsequently interrupted or the voltage and frequency of the AC input are not within the programmed limits or the AC input breaker marked "Charger" trips due to overload in the AC by-pass load circuit, the unit will shut down completely: • Transfer Relay trips • LCD displays: "Fault Mode, Short Circuit" **NOTE:** The unit will get latched in this condition and will not switch OFF through the ON / OFF Key. To reset, remove the DC and AC input connection, wait for 5 minutes, reconnect and then switch ON
Overload on AC output side in Utility / Generator Mode	If the combined AC side charging current and the pass-through load current exceeds the capacity of the Circuit Breaker marked "Charger" (40A for G4-2012 and G4-2524 and 60A for G4-3524), this breaker will trip. Charging will stop and pass-through load will be transferred to the Inverter Section. Overload protection of the Inverter Section will be provided as explained below against "Overload in Inverter Mode"
Over load in Inverter Mode	Electronic overload shut down in 100 ms if load is >200% of rated Continuous Active Output Power • LCD displays: "Fault Mode, Fault Mode"
	Electronic overload shut down in 20 sec if load is >150% of rated Continuous Active Output Power • LCD displays: "Fault Mode, 150% overload"
	Electronic overload shut down in 60 sec if load is >130% of rated Continuous Active Output Power • LCD displays: "Fault Mode, 130% overload"
	Electronic shut down in 15 min if load is >110% of rated Continuous Active Output Power (When started in cold condition) • LCD displays: "Fault Mode, 110% overload"
	Shut down due to tripping of Circuit Breaker marked "Load" due to continuous overload > the rated capacity of the breaker (30 A for G4-2012A, 35A for G4-2524A and 40A for G4-3524A) • LCD displays: " Fault Mode, Short Circuit"
Over temperature	Shut down if H-Bridge Mosfet heat-sink temperature ≥ 105° C for more than 30 sec. Shut down immediately if temperature is ≥ 140°C • LCD displays: " Fault Mode, Over - temperature"
	Shut down if main transformer temperature is ≥ 140°C • LCD displays: "Fault Mode, Over - temperature"
	If main transformer temperature is ≥ 120° C, charger current is reduced to 50%

SECTION 9 | Protections, Operational Monitoring & Fault Diagnosis

TABLE 9.3: PROTECTIONS AND ASSOCIATED LCD DISPLAY MESSAGES	
AC input wiring from utility / generator is connected to AC output terminals instead of AC Input Terminals and hence, creating back-feed condition	Unit will not boot / switch ON. LCD displays: "Wiring Error"
Low DC input voltage due to weak/bad battery: No DC input voltage due to blowing of external DC fuse as a result of overload or reverse polarity (AC input is available). **CAUTION! Reverse polarity is likely to cause permanent damage and is not covered by warranty.**	DC input voltage is < 5V for the 12V version or < 10V for the 24V version due to (i) Bad battery and (ii) Blowing of external DC input fuse due to overload or reverse polarity. • LCD displays: "Bad Battery" • Unit will not switch off with the On / Off Key. Disconnect AC and DC input connections. Fully charge the battery by external charger or replace with a new, fully charged battery. Reconnect the AC and DC input connections and restart. DC input voltage is < 9V for the 12V version or < 18V for the 24V version • LCD displays "Battery Weak" • **CAUTION!** Do not switch off the unit with the ON / OFF Key. Disconnect AC and DC input connections. Fully charge the battery by external charger or replace with new, fully charged battery. Reconnect the AC and DC input connections and restart.
Limit distortion of generator AC output waveform due to overload by interrupting charging if generator frequency is not within the range of 45 to 65 Hz.	• Display screens "Battery Charging" (SCREEN 4, page 52) and "Charging Mode" (SCREEN 6, page 52) will show message "Inp Hz Abnormal" • Display screen showing Internal (Int) and External (Ext) charging Amps (SCREEN 5, page 52) will display 0 A against Internal (Int) Amps • Charging is resumed once the frequency of the generator is within the window of 45 Hz to 65 Hz.

SECTION 9 | Protections, Operational Monitoring & Fault Diagnosis

Verouillage dû aux conditions défectueuse et, redémarrage.

ATTENTION!

Veuillez noter que le «Verouillage» du système indique que la sortie est arrêtée mais que l'appareil n'est pas complètement fermer.

L'appareil se verrouille quand il y a certains défauts critiques et aurait besoin d'être redémarrer. Fermer l'appareil en utilisant interrupteur ON/OFF. Corrigez le défaut et puis rallumez l'appareil.

Dans certains cas, l'appareil ne peut pas fermer. Si c'est le cas, enlevez les connexions d'entrée CA et CC, attendez 5 minutes, et ensuite rebranchez-les et allumez l'appareil (ON).

Protections

La table 9.2 énumère les protections qui sont comprises pour la sécurité et une fonctionnement fiable:

TABLE 9.2: PROTECTIONS

Symptôme	*DEL «Statut» - Verte*	*DEL «Défaut» - Rouge*	*Alarme*	*Message affiché ACL et action réparateur*
Entrée CC trop faible - Alarme «inverter mode» *11,0 vCC ± 0,3 vCC pour la batterie de 12v* *22,0 vCC ± 0,6 vCC pour la batterie de 24v*	*Clignote une fois @ 2 sec*	*Clignote une fois @ 0,5 sec*	*Sonne 3 fois par 30 sec*	
Entrée CC trop faible - verrouillage section onduleur/ «inverter mode» *10,0 vCC ± 0,3 vCC pour la batterie de 12v* *20,0 vCC ± 0,6 vCC pour la batterie de 24v*	*FERMER*	*FERMER*		*FERMER*
La tension de Sortie CC du chargeur CA interne est trop forte («Utility/Generator» mode) ***Dans la mode normale «3 stage Charging»:*** • *Tension > augmentation programmée (Absorption) Tension ± 0,3v (batterie de12v)* • *Tension > augmentation programmée (Absorption) Tension ± 0,6v (batterie de 24v)* ***Dans la mode «4 stage equalization»:*** • *Tension> Égalisation de tension programmé Tension ± 0,3v (batterie de12v)* • *Tension> Égalisation de tension programmé Tension ± 0,6v (batterie de 24v)*	*FERMER*	*ALLUMER*	*Sonne une fois @ 0,5 sec*	*Le chargeur est fermé*
Protection: la tension de sortie CC du chargeur CA interne est trop forte pendant 30 secondes (mode «Utility/Generator») ***Dans la mode normale «3 stage Charging»:*** • *Tension > augmentation programmée (Absorption) Tension + 0,8 v ± 0,3v (batterie de12v)* • *Tension > augmentation programmée (Absorption) Tension +1,6v ± 0,6v (batterie de 24v)* ***Dans la mode «4 stage equalization»:*** • *Tension > Égalisation de tension programmé Tension + 0,6v ± 0,3v (batterie de12v)* • *Tension> Égalisation de tension programmé Tension 1,2v ± 0,6v (batterie de 24v)*	*FERMER*	*Clignote*	*Sonne trois fois @ 0,5 sec*	*Le chargeur est fermé* *L'appareil se met dans la mode «inverter mode»*
Courant de charge excessif: *- 95A pour le G4-2012* *- 85A pour le G4-2524* *- 85A pour le G4-3524* *(la mode «Utility / Generator mode»)*	*FERMER*	*ALLUMER*	*Sonne pendant 5 minutes*	*Le chargeur est fermé* *Aucun message est affiché*
Surcharge de la section onduleur à 110% (la mode «Inverter mode»)	*Clignote une fois @ 2 sec*	*ALLUMER*	*Sonne une fois @ 0,5 sec*	*La sortie se verrouille après 15 mins* *ACL affiche «Fault Mode, 110% Overload»*

SECTION 9 | Protections, Operational Monitoring & Fault Diagnosis

TABLE 9.2: PROTECTIONS

Symptôme	*DEL «Statut» - Verte*	*DEL «Défaut» - Rouge*	*Alarme*	*Message affiché ACL et action réparateur*
Surcharge de la section onduleur à 130% (la mode «Inverter mode»)	*Clignote une fois @ 2 sec*	*ALLUMER*	*Sonne Constam-ment*	*La sortie se verrouille après 60 secs* *ACL affiche «Fault Mode, 130% Overload*
Surcharge de la section onduleur à 150% (la mode «Inverter mode»)	*Clignote une fois @ 2 sec*	*ALLUMER*	*Sonne Constam-ment*	*La sortie se verrouille après 20 secs* *Overload" ACL affiche «Fault Mode, 150% Overload»*
Surcharge de la section onduleur à 200% (la mode «Inverter mode»)	*FERMER*	*ALLUMER*	*Sonne pendant 5 minutes*	*ACL affiche «Fault Mode, Fault Mode»*
Court-circuit du côté de sortie CA (la mode «Inverter mode»	*FERMER*	*ALLUMER*	*Sonne pendant 5 minutes*	*La sortie se verrouille immédiatement: ACL affiche «Fault Mode, Short-circuit»* *La sortie marcherait encore si le court-circuit dure < 10 secs* *L'interrupteur ON/OFF ne marche pas* *Pour remettre à l'état, déconnectez et reconnectez la puissance d'entrée CA et CC*
Surchauffe du dissapateur de chaleur pour les «H-bridge MOSFETs» *- La température du dissapateur de chaleur est ≥ 105° C*	*ALLUMER*	*ALLUMER*	*Sonne pendant 5 minutes*	*La sortie se verrouille après 30 secondes* *ACL affiche «Fault Mode, Over temperature»*
Surchauffe du dissapateur de chaleur pour les «H-bridge MOSFETs» *- La température du dissapateur de chaleur est ≥ 140° C*	*FERMER*	*ALLUMER*	*Sonne pendant 5 minutes*	*La sortie se verrouille immédiatement* *ACL affiche «Fault Mode, Over temperature»*
Surchauffe des enroulements de transformateur bi-directionales *- La température de l'enroulement est ≥ 140° C*	*FERMER*	*ALLUMER*	*Sonne pendant 5 minutes*	*La sortie se verrouille immédiatement* *ACL affiche «Fault Mode, Over temperature»*
La température de l'enroulement est ≥ 120° C (mode Utilitaire/Générateur)	*ALLUMER*	*ALLUMER*	*Sonne pendant 5 minutes*	*Réduire le courant de charge à 50%*

SECTION 9 | Protections, Operational Monitoring & Fault Diagnosis

TABLE 9.2: PROTECTIONS

Symptôme	*DEL «Statut» - Verte*	*DEL «Défaut» - Rouge*	*Alarme*	*Message affiché ACL et action réparateur*
Batterie faible *i) Tension d'entrée CC < 5v pour le G4-2012Aou < 10v pour le G4-2524A/G43524A*	*FERMER*	*Clignote une fois @ 0,5 sec*	*Sonne une fois @ 0,5 sec*	***ATTENTION!*** *N'appuyez pas sur l'interrupteur ON/OFF* *Déconnectez la puissance d'entrée CA* *Déconnectez la connexion d'entrée CC* *Recharger la batterie avec un chargeur externe ou remplacez-la* *Remettez la batterie et la puissance d'entrée CA*
Mauvaise Batterie *i) Tension d'entrée CC < 5v pour le G4-2012A ou < 10v pour le G4-2524A/G43524A* *ii) Fusible externe d'entrée CC explosé dû à une surcharge, polarités renversé (l'entrée CA est disponible)* ***ATTENTION!*** ***Des dégats causés par un renversement des polarités n'est pas couverts par la garantie.***	*FERMER*	*ALLUMER*	*Sonne Constam-ment*	*Déconnectez la puissance d'entrée CA* *Déconnectez la connexion d'entrée CA* *Rechargez la batterie en utilisant un chargeur externe ou remplacez la batterie/ le fusible* *Reconnectez la batterie et la puissance d'entrée CA*
Erreur de câblage	*FERMER*	*ALLUMER*	*Sonne Constam-ment*	*Le câblage d'entrée CA de l'Utilitaire/ Générateur est mal branché aux bornes de sortie CA* *Connectez le câblage correctement*

Protections et diagnostic des défauts affiché par l'ACL Alphanumérique

Les détails par message diagnostic affiché sur l'ACL alphanumérique qui sont liés au verouillage dû a des conditions défectueuses sont donnés ci-dessous dans la table 9,3. Des détails des seuils pour l'activation du verouillage et les DELs et/ou alarme associées se trouvent dans la table 9.2,à la page 62 & 64. Quand l'appareil se verrouille, il faut le remettre en marche manuellement.Pour le faire, fermez l'appareil, corrigez le défaut et rallumez l'appareil.

Dans certains cas, l'appareil ne peut pas fermer. Si c'est le cas, enlevez les connexions d'entrée CA et CC, attendez 5 minutes, et ensuite rebranchez-les et allumez l'appareil (ON).

SECTION 9 | Protections, Operational Monitoring & Fault Diagnosis

TABLE 9.3: PROTECTIONS ET MESSAGES AFFICHÉ SUR L'ACL	
Court-circuit sur le côté de sortie CA, la mode «Utility/ Generator mode »	*L'entrée CA est déconnecter dû au déclenchement du disjoncteur marqué «Charger» (40A pour le G4-2012, G4-2524 et 60A pour le G4-3524).La charge serait transferée à la section onduleur. La protection de court-circuit est activée et la section onduleur se verouille.* *• ACL affiche «Fault Mode, Short-circuit»*
Court-circuit dans la section de rechargement, la mode « Utility/Generator mode »	*L'appareil se verrouille si le court-circuit dure plus que 10 secondes:* *• Le relais transferé serait déchargé* *• Le rechargement serait arrêté* *• Le by-pass de sortie CA serait verrouillé* *• ACL affiche «Fault Mode, Short-circuit»*
Court-circuit sur le côté de sortie CA, la mode «inverter mode»	*L'onduleur se verrouille si le court-circuit dure plus que 10 secondes:* *• ACL affiche «Fault Mode, Short-circuit»*
Une surcharge constante > la capacité du disjoncteur marqué «Load» dan la mode «Utility/Generator mode» *• 30A pour le G4-2012A* *• 35A pour le G4-2524A* *• 40A pour le G4-3524A*	*Le Disjoncteur Marqué «Load» va déclencher et le rechargement va arrêter:* *• L'étape de rechargement quand le disjoncteur a déclencher est affiché - «SCREEN 6» (à la pages 43 & 44)* *• 0A et 0v sont affichés - «SCREEN 4» (à la page 43)* *• 0A est affiché pour le chargeur interne- «SCREEN 4» (à la page 43)* *• Le relais transferé reste chargé. La sortie «Pass-through» CA est toujours disponible à travers le disjoncteur d'entrée CA marqué «Charger»* *Si l' entrée CA est interrompu ou la tension et fréquence de l' entrée CA sont pas dans la limite choisie ou le disjoncteur d'entrée CA marqué «Charger» déclenche dû à la surcharge du circuit de charge by-pass CA. l'appareil ferme complètement.* *• Le relais transferé déclenche* *• ACL affiche «Fault Mode, Short-circuit»* ***NB:** l'appareil ne ferme pas dans cette condition si l'interrupteur ON/OFF est appuyé. Il faut enlever les connexions d'entrée CC et CA, attendre 5 minutes et reconnecter les et puis rallumer l'appareil.*
Une surcharge sur le côté de sortie CA dans la mode «Utility/Generator mode»	*Si la combinaison de courant de recharge du côté CA et le courant de charge «Pass-through» excède la capacité du disjoncteur marqué «Charger» (40A for G4-2012 and G4-2524 and 60A for G4-3524), ce disjoncteur va déclencher. Le rechargement arrête et la charge «pass-through» serait transferé à la section onduleur. Une protection contre la surcharge est activée comme expliquée ci-dessous.*
Une surcharge dans la mode «inverter mode»	*Une surcharge électrique, verouillage en 100 ms si la charge >200% de la puissance délivrée active classifiée* *• ACL affiche «Fault Mode, Fault Mode»*
	Une surcharge électrique, verouillage en 20 sec si la charge >150% de la puissance délivrée active classifiée *• ACL affiche «Fault Mode, 150% Overload»*
	Une surcharge électrique, verouillage en 60 sec si la charge >130% de la puissance délivrée active classifiée *• ACL affiche «Fault Mode, 130% Overload»*
	Une surcharge électrique, verouillage en 15 min si la charge >110% de la puissance délivrée active classifiée (Quand c'est démarré avec une condition froide) *• ACL affiche «Fault Mode, 110% Overload»*
	Verrouillage dû au déclenchement du disjoncteur marqué «Load» pendant une surcharge constante > la capacité classifié du disjoncteur (30 A pour le G4-2012A, 35A pour le G4-2524A et 40A pour le G4-3524A) *• ACL affiche «Fault Mode, Short-circuit»*
Une surchauffe	*Verrouillage si la température du dissapateur de chaleur est ≥ 105° C pendant au moins 30 secondes* *• ACL affiche «Fault Mode, Over temperature»*
	Verrouillage si la température du dissapateur de chaleur est ≥ 140° C *• ACL affiche «Fault Mode, Over temperature»*
	Si le transformateur principal est ≥ 120° C, le courant du chargeur est réduit par 50%
Le câblage d'entrée CA de l'utilitaire/générateur est connecté aux bornes de sortie au lieu des bornes d'entrée CA et ainsi, creant une condition de «retour»	*L'appareil ne démarre pas. L'ACL affiche le message «Wiring Error»*
Faible tension d'entrée CC dû une mauvaise/faible batterie *Aucune tension CC dù à l'explosion du fusible externe CC dû à une surcharge ou des polarités renversés (entrée CA est toujours disponible)* ***ATTENTION! Des dégats causés par un renversement des polarités n'est pas couverts par la garantie.***	*La tension d'entrée CC est < 5v pour le système de 12v ou < 10v pour le systèmem de 24v* *• ACL affiche «Bad Battery»* *• L'appareil ne ferme pas en appuyant l'interrupteur ON/OFF. Déconnectez les connexions d'entrée CA et CC. Rechargez la batterie avec un chargeur externe ou remplacez-la. Rebranchez les connexions d'entrée CA et CC et puis redémarrer l'appareil.* *La tension d'entrée CC est < 9v pour le système de 12v ou < 18v pour le système de 24v* *• ACL affiche «Battery Weak»* *• **ATTENTION!** Ne fermez pas l'appareil en appuyant l'interrupteur ON/OFF. Déconnectez les connexions d'entrée CA et CC. Rechargez la batterie avec un chargeur externe ou remplacez-la. Rebranchez les connexions d'entrée CA et CC. et puis redémarrez l'appareil.*

SECTION 10 | Specifications

Product Highlights

Model No.	Power Rating*	Input Connections	Circuit Breaker "Charger"	Circuit Breaker "Load"	Output Connections
G4-2012A	2000 VA	• Terminal Block, 65A for AC input • M8 stud and nut for DC input • M8 thumb nut for external charger input	40A	30A	Terminal Block, 65A for AC output
G4-2524A	2500 VA		40A	35A	
G4-3524A	3500 VA		60A	40A	

* Power rating is shown as Apparent Power in Volt Amp (VA). Active Power in Watts will be controlled by the Power Factor of the AC side load i.e. Active Power in Watts = Apparent Power in VA x Power Factor (normally ranges from 0.5 to 1). For resistive type of loads with Power Factor of 0.9 to 1, the Apparent Power in VA will be almost equal to the Active Power in Watts.

Utility / Generator Pass Through (Bypass) Mode - External AC Line Input Is Available

Parameter	G4-2012A	G4-2524A	G4-3524A
Input Voltage Waveform	Pure Sine Wave		
Input Voltage range	120 VAC nominal (80 VAC to 140 VAC ± 4%)		
Input Voltage: Low Line Disconnect	Programmable: 80 VAC to 95 VAC ± 4%		
Input Voltage: Low Line Re-connect	10V higher than programmed value of Low Line Disconnect		
Input Voltage: High Line Disconnect	Programmable:130 VAC to 140 VAC ± 4%		
Input Voltage: High Line Re-connect	5 V lower than the programmed value of High Line Disconnect		
Nominal Input Frequency	50Hz / 60Hz (Auto detection) Default: 60Hz for 120V version		
Low Frequency Disconnect	57 ± 0.3Hz for 60Hz / 47 ± 0.3Hz for 50Hz		
Low Frequency Re-connect	58 ± 0.3Hz for 60Hz / 48 ± 0.3Hz for 50Hz		
High Frequency Disconnect	65 ± 0.3Hz for 60Hz / 55 ± 0.3Hz for 50Hz		
High Frequency Re-connect	64 ± 0.3Hz for 60Hz / 54 ± 0.3Hz for 50Hz		
Maximum AC Input Current	40A, limited by Circuit Breaker marked "Charger"	40A, limited by Circuit Breaker marked "Charger"	60A, limited by Circuit Breaker marked "Charger"
Output Voltage Waveform	Same as waveform of Line input voltage		
Output Overload and Short Circuit Protections	40A Circuit Breaker marked "Charger"	40A Circuit Breaker marked "Charger"	60A Circuit Breaker marked "Charger"
Efficiency (Pass Through / Bypass Condition)	> 95% (When battery is fully charged)		
Transfer Relay Rating	• 80A, 277 VAC (Two 40A relays in parallel) for the Line side (120V version) • 80A, 277 VAC (Two 40A relays in parallel) for Neutral side for Neutral to Chassis Ground switching		
Transfer Time (Utility / Generator to Inverter)	20 ms (Typical)		
Minimum DC Input Voltage for Pass Through (Bypass) and Charging	9V	18V	18V
Maximum Pass Through (Bypass) Overload Current	40A for G4-2012A	40A for G4-2524A	60A for G4-3524A

SECTION 10 | Specifications

Inverter Section

Parameter	G4-2012A	G4-2524A	G4-3524A
AC OUTPUT SIDE IN INVERTER MODE			
Nominal Output Voltage	120 VAC		
Output Voltage Regulation	± 10% RMS (Before Low Battery Alarm)		
Nominal Output Frequency	60 / 50 Hz ± 0.3Hz (Auto sensing based on AC input frequency. Default is 60 Hz)		
Output Voltage Waveform	Pure Sine Wave		
Total Harmonic Distortion (Fully Linear Load)	< 6% (Before Low DC Input Voltage Alarm)	< 3% (Before Low DC Input Voltage Alarm)	<5% (Before Low DC Input Voltage Alarm)
Max. Continuous Output Power and Current	2000 VA / 16.7A	2500 VA / 20.8A	3500 VA / 29.0A
300% Surge Output Power and Current for 1ms	6000 VA / 50.0A	7500 VA / 62.4A	10,500 VA / 87.0A
200% Surge Output Power and Current for 100 ms	4000 VA / 33.4A	5000 VA / 41.6A	7000 VA / 58.0A
150% Overload Limit, 20 sec	3000 VA / 25A	3750 VA / 31.3A	5250 VA / 43.8A
130% Overload Limit, 60 sec	2600 VA / 21.7A	3250 VA / 27.1A	4550 VA / 37.9A
110% Overload Limit, 15 min (Started in cold condition)	2200 VA / 18.3A	2750 VA / 22.9A	3850 VA / 32.1A
Load Crest Factor	3	3	3
Nominal Efficiency (Peak)	82%	86%	86%
Output Short Circuit Protection (Shut Down)	• By voltage detection (< 60 VAC at 1.5th cycle or < 90 VAC at 5.5th cycle) over a period of 10 sec. • Auto reset if short circuit condition lasts for < 10 sec. Manual reset thereafter		
DC INPUT SIDE IN INVERTER MODE			
Nominal DC Input Voltage	12V (10 to 16.8V ± 0.3V)	24V (20 to 33.6V ± 0.6V)	24V (20 to 33.6V ± 0.6V)
DC Input Voltage Range (Before Low DC Input Voltage Alarm)	> 11 ± 0.3V < (V-Boost + 0.8) ± 0.3V	> 22 ± 0.6 VDC < (V-Boost + 1.6) ± 0.6 VDC	> 22 ± 0.6 VDC < (V-Boost + 1.6) ± 0.6 VDC
Minimum DC Voltage to Start	>10V	>20V	>20V
Maximum DC Input Current at Continuous Rated AC Output	250A @ 10V	150A @ 20V	215A @ 20V
Maximum DC Input Current during 300% Surge for 1 msec	875A	525A	752A
Maximum DC Input Current during 200% Surge for 100 msec	750A @ 10V	450A @ 20V	645A @ 20V
Maximum DC Input Current during 150% Overload for 20 sec	500A @ 10V	300A @ 20V	450A @ 20V
Maximum DC Input Current at 130% Overload for 60 sec	375A @ 10V	225A @ 20V	322A @ 20V
Maximum DC Input Current at 110% Overload for 15 min	312A @ 10V	188A @ 20V	268A @ 20V
Maximum allowable External DC Fuse Rating	350A / 32V	200A / 32V	300A / 32V
Low DC Input Voltage Alarm	11.0 VDC ± 0.3 VDC	22.0 VDC ± 0.6 VDC	22.0 VDC ± 0.6 VDC
Low DC Input Voltage Shut-down	10.0 VDC ± 0.3 VDC	20.0 VDC ± 0.6 VDC	20.0 VDC ± 0.6 VDC

SECTION 10 | Specifications

Parameter	G4-2012A	G4-2524A	G4-3524A
High DC Input Voltage Alarm & Fault: • In normal 3 Stage Charging Mode • In 4 Stage Equalization Mode	(V-Boost +0.8V) ± 0.3V (V Equalization + 0.6V) ± 0.3V	(V-Boost +1.6V) ± 0.6V (V-Equalization + 1.2V) ± 0.6V	(V-Boost +1.6V) ± 0.6V (V-Equalization + 1.2V) ± 0.6V
High DC Input Recovery	V-Boost ± 0.3V	V-Boost ± 0.6V	V-Boost ± 0.6V
No Load Power Consumption in Normal Mode	35W	45W	45W
POWER SAVE MODE			
Method of load sensing	Outputs 2 to 3 cycles of 40 VAC load sensing pulses every 2.8 sec		
Value of load to activate and de-activate Power Save Mode	Load < 10W — Activate Power Save Mode; Load > 60W — Return to Normal Mode		
No Load power consumption in Power Save Mode	5 W		

Battery Charger Section

Parameter	G4-2012A	G4-2524A	G4-3524A
Nominal Input Voltage	120 VAC		
Programmable Input Voltage Range	80 VAC to 140 VAC ± 4%		
Nominal Input Frequency	50Hz / 60Hz (Auto detection); Default: 60 Hz		
Input Frequency Range	Utility Mode: 57 to 65 Hz for 60 Hz; 47 to 55 Hz for 50 Hz Generator Mode: 45 to 65 Hz		
Input Power Factor	> 0.8		
Input Current Crest Factor	< 3.0		
Maximum rated AC Input Current	20A @ 120 VAC 28A @ 85 VAC	25A @ 120 VAC 35A @ 85 VAC	34A @ 120 VAC 48A @ 85 VAC
Max AC Input Current at Short Circuit	80A	90A	120A
Bulk Charging Current	• Maximum: 80A ± 5A • Programmable range: • 10A to 80A (Steps of 10A) • Default: 10A	• Maximum: 70A ± 5 A • Programmable range: 10A to 70A (Steps of 10A) • Default: 10A	• Maximum: 70A ± 5 A • Programmable range: 10A to 70A (Steps of 10A) • Default: 10A
Boost (Absorption) Voltage	• Programmable range: 14 to 16 VDC • Default: 14.4 VDC	• Programmable range: 28 to 32 VDC • Default: 28.8 VDC	• Programmable range: 28 to 32 VDC • Default: 28.8 VDC
Boost (Absorption) Time	Automatic — based on the amount of time the battery remains in the Bulk Stage: Minimum — 1 hour Maximum — 12 hours		
Float Voltage	Programmable range: 13 to 15 VDC • Default: 13.8 VDC	Programmable range: 26 to 30 VDC • Default: 27.6 VDC	Programmable range: 26 to 30 VDC • Default: 27.6 VDC
Equalization Voltage	Programmable range: 14 to 16 VDC • Default: 15.3 VDC	Programmable range: 28 to 32 VDC • Default: 30.6 VDC	Programmable range: 28 to 32 VDC • Default: 30.6 VDC

SECTION 10 | Specifications

Parameter	G4-2012A	G4-2524A	G4-3524A
BATTERY CHARGER SECTION (CONTINUED)			
Equalization Current	Automatic - 0.5 times the set value of Bulk Charge Current		
Equalization Time	Automatic - based on the time the battery remains in Bulk Stage		
Maximum Charging Efficiency	70% at charging current = 45A	80% at charging current = 20A	80% at charging current = 20A
Battery Initial Voltage	9 to 16 VDC	18 to 32 VDC	18 to 32 VDC
Over Charge Current Protection	95A (Shut down charging)	85A (Shut down charging)	85A (Shut down charging)
Battery Charging Voltage Temperature Compensation (with external Battery Temperature Sensor Model BTS-G4)	• Compensation is effective over temperature range of - 20°C to + 50°C • Programmable Coefficient of Compensation: -3 to - 5 m V / °C / cell • Default: - 4 mV / °C / cell Reference: 25°C		
External DC Fuse Protection (Max.)	320A	195A	290A
Over Voltage Protection and Alarm	> Programmed Boost Voltage > Programmed Equalization Voltage • Charger off • Green LED - OFF; Red LED - ON • 1 beep @ 0.5 sec		
	> Programmed Boost Voltage + 0.8V for 30 sec > Programmed Equalization Voltage + 0.6V for 30 sec • Charger off. Transfer to Inverter Mode • Green LED OFF; Red LED blinks • 3 beeps @ 5 sec	> Programmed Boost Voltage + 1.6 V for 30 sec > Programmed Equalization Voltage + 1.2 V for 30 sec • Charger off. Transfer to Inverter Mode • Green LED OFF; Red LED blinks • 3 beeps @ 5 sec	> Programmed Boost Voltage + 1.6 V for 30 sec > Programmed Equalization Voltage + 1.2 V for 30 sec • Charger off. Transfer to Inverter Mode • Green LED OFF; Red LED blinks • 3 beeps @ 5 sec
Parallel operation with external charger	Yes. The total charging current will follow the programmed Bulk Current setting.		
Charging voltage range with external charger	13 to 16 VDC	26 to 32 VDC	26 to 32 VDC
Maximum charging current with external charger	50A	50A	50A

General

Parameter	G4-2012A	G42524A	G4-3524A
Safety Compliance	• Intertek-ETL listed: Conforms to ANSI / UL STD. 1741 • Intertek-ETL listed: Certified to CAN / CSA STD. C22.2 No. 107.1-01 • Intertek-ETL listed: Conforms to ANSI / UL STD. 458		
EMI / EMC Compliance	• Certified to FCC Part 15(B), Class A • Certified to ISO 7637-2 for immunity against conducted electrical transients in vehicles		
Operating Temperature Range	0°C to +50°C / 32°F to 120°F		
Storage Temperature	-15° C to +60°C / 5°F to 140°F		
Operating Humidity	5% to 95%		
Audible Noise	Maximum 65 dBA from distance of 1 meter		
Earthing	External Earth Ground terminal for connecting the Equipment Grounding Conductor		
Dimensions (W x D x H) millimeters Dimensions (W x D x H) inches	218 x 558 x 198 mm 8.6" x 22" x 7.8"		
Weight (kg., Lb)	24.1 Kg, 53.0 lb.	24.6 Kg, 54.1 lb.	26.1 Kg , 57.4 lb.

SECTION 11 | Warranty

2 YEAR LIMITED WARRANTY

G4-2012A, G4-2524A and G4-3524A manufactured by Samlex America, Inc. (the "Warrantor") is warranted to be free from defects in workmanship and materials under normal use and service. The warranty period is 2 years for the United States and Canada, and is in effect from the date of purchase by the user (the "Purchaser").

Warranty outside of the United States and Canada is limited to 6 months. For a warranty claim, the Purchaser should contact the place of purchase to obtain a Return Authorization Number.

The defective part or unit should be returned at the Purchaser's expense to the authorized location. A written statement describing the nature of the defect, the date of purchase, the place of purchase, and the Purchaser's name, address and telephone number should also be included.

If upon the Warrantor's examination, the defect proves to be the result of defective material or workmanship, the equipment will be repaired or replaced at the Warrantor's option without charge, and returned to the Purchaser at the Warrantor's expense. (Contiguous US and Canada only)

No refund of the purchase price will be granted to the Purchaser, unless the Warrantor is unable to remedy the defect after having a reasonable number of opportunities to do so. Warranty service shall be performed only by the Warrantor. Any attempt to remedy the defect by anyone other than the Warrantor shall render this warranty void. There shall be no warranty for defects or damages caused by faulty installation or hook-up, abuse or misuse of the equipment including exposure to excessive heat, salt or fresh water spray, or water immersion.

No other express warranty is hereby given and there are no warranties which extend beyond those described herein. This warranty is expressly in lieu of any other expressed or implied warranties, including any implied warranty of merchantability, fitness for the ordinary purposes for which such goods are used, or fitness for a particular purpose, or any other obligations on the part of the Warrantor or its employees and representatives.

There shall be no responsibility or liability whatsoever on the part of the Warrantor or its employees and representatives for injury to any persons, or damage to person or persons, or damage to property, or loss of income or profit, or any other consequential or resulting damage which may be claimed to have been incurred through the use or sale of the equipment, including any possible failure of malfunction of the equipment, or part thereof. The Warrantor assumes no liability for incidental or consequential damages of any kind.

Samlex America Inc. (the "Warrantor")
www.samlexamerica.com

SECTION 11 | Garantie

GARANTIE LIMITEE SOUS 2 ANS

G4-2012A, G4-2524A et G4-3524A, fabriqués par Samlex America, Inc. (le « Garant ») sont garantis être non défectueux dans la conception et dans les matériaux, moyennant une utilisation et un service normaux. La période de garantie est de 2 ans pour les Etats-Unis et le Canada, et prend effet le jour de l'achat par l'utilisateur (« l'Acheteur »).

La garantie hors des Etats Unis et du Canada est limitée à 6 mois. Pour une réclamation concernant la garantie, l'Acheteur devra contacter le point de vente ou l'achat a été effectué afin d'obtenir un Numéro d'Autorisation pour le Retour.

La pièce ou l'unité défectueuse devra être retournée aux frais de l'acheteur au point de vente agrée. Une déclaration écrite décrivant la nature du défaut, la date et le lieu d'achat ainsi que le nom, l'adresse et le numéro de téléphone de l'Acheteur devront également être renseignés.

Si a l'examination de la demande par le Garant, le défaut est réellement le résultat d'un matériau ou d'un assemblage défectueux, l'équipement sera réparé ou remplacé gratuitement et renvoyé a l'Acheteur aux frais du Garant. (Etats-Unis et Canada uniquement).

Aucun remboursement du prix d'achat ne sera accorde a l'Acheteur, sauf si le Garant est incapable de remédier au défaut après avoir eu plusieurs occasion de le faire. Le service de garantie doit être effectue uniquement par le Garant. Toute tentatives de remédier au défaut par quelqu'un d'autre que le Garant rendent cette garantie nulle et sans effet. Il n'existe aucune garantie concernant les défauts ou dommages causés par une installation défectueuse ou inadaptée, par un abus ou une mauvaise utilisation de l'équipement, y compris, une exposition excessive a la chaleur, au sel, aux éclaboussures d'eau fraiche ou a l'immersion dans l'eau.

Aucune autre garantie express n'est accordée et il n'existe aucunes garanties qui s'étendent au delà des conditions décrites par la présente. Cette garantie est la seule garantie valable et reconnue par le Garant, et prédomine sur d'autres garantie implicites, y compris les garanties implicites liées a la garantie de qualité marchande, a l'usage des objectifs habituels pour lesquels de telles marchandises sont utilisées, ou l'usage pour un objectif particulier, ou toutes autres obligations de la part du Garant ou de ses employés et représentants.

Il ne doit pas exister de responsabilité ou autre de la part du Grant ou des ses employés et représentants, en ce qui concerne les blessures corporelles, ou les dommages de personne a personne, ou les dégâts sur une propriété, ou la perte de revenus ou de bénéfices, ou autres dommages collatéraux, pouvant être rapportés comme ayant survenus au cours de l'utilisation ou de la vente du matériel, y compris tous disfonctionnements ou échecs du matériel, ou une partie de celui-ci. Le Garant n'assume aucune responsabilité concernant toutes sortes de dommages accidentels ou indirects.

Samlex America Inc. (le « Garant »)
www.samlexamerica.com

Contact Information

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Fax: 1.888.814.5210

Local Numbers
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Fax: 604.525.5221

Website
www.samlexamerica.com

USA Shipping Warehouse
Kent WA

Canadian Shipping Warehouse
Delta BC

Email purchase orders to
orders@samlexamerica.com

samlexamerica®

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